# ETHERNET ON TWISTED PAIR ►

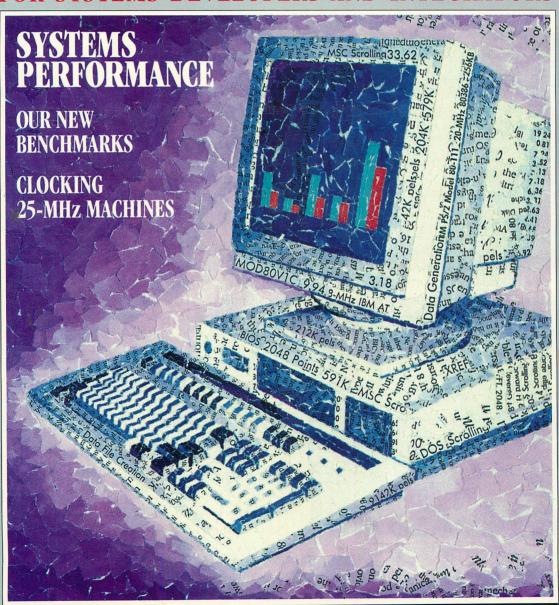
# DYNAMIC LINK LIBRARIES

SEPTEMBER 1988

VOL. 6 NO. 9 \$3.95

# OURNAL DOUGH

FOR SYSTEMS DEVELOPERS AND INTEGRATORS





# Our new MASM 5.1 gives you two things you've never had in a macro assembler.

# MS OS/2 and spare time.

| _DATA<br>DATA | SEGMENT.<br>ENDS | WORD PUBLIC 'DATA'     |   |
|---------------|------------------|------------------------|---|
| DGROUP        | GROUP            | DATA                   |   |
| TEXT          | SEGMENT          | WORD PUBLIC CODE       |   |
|               | ASSUME           | CS:_TEXT,DS:DGROUP,SS: | DGROUP  |
|               | PUBLIC           | _ShiftfNorm            |   |
| _ShiftNsum    |                  | NEAR                   |   |
|               | push             | bp                     | , setup stack frame with                              |
|               | mov<br>sub       | bp,sp                  |   |
|               | push             | ερ. 2<br>CX            | one local variable [bp-2                              |
|               | mov              | WORD PTR [bp-2]_0      | ; save CX used during routing<br>clear local variable |
|               | mov              | Cx, WORD PTR [bp+4]    | ; fetch number of sums                                |
| Sumlp:        | mov              | Ax.[BP+6]              | , return number of sums                               |
| Contrap.      | shi              | Ax.cl                  | ; double value in ax, al time:                        |
|               | add              | WORD PTR [bp-2] ax     | , doodle value at all of time                         |
|               | loop             | Sumlp                  |   |
|               | mov              | Ax. WORD PTR [bp-2]    | return value in ax                                    |
|               | pop              | CX                     | , restore cx  |
|               | mov              | sp.bp                  |   |
|               | pop              | bp                     | ; restore stack and return                            |
|               | ret              |                        |   |
| _Shiftl\loum  | endp             |                        |   |
| _TEXT         | ends<br>end      |                        |   |

The old way: slow, cumbersome coding.

| MODI<br>CODE<br>ShiffNsum PROC<br>LOCA | USES cx, Nur<br>USES cx, Nur<br>USES cx, Nur   | nber: Word, sums: Word<br>, declare a stack local |
|--|--|---|
| mov<br>mov<br>Sumlp: mov               | sumresult 0<br>Cx, sums<br>Ax, number          | ; clear sumresult<br>; fetch number of sums       |
| shi<br>add<br>loop<br>mov              | Ax,cl<br>sumresult,ax<br>Sumlp<br>ax,sumresult | ; double value in ax of time:                     |
| ShiftNsum endp                         | ux,sumresum                                    | , return value in ax                              |
|  |  |   |
|  |  |   |
|  |  |   |

The new way: time off for good behavior.

As a professional programmer you know how fast MASM subroutines make your programs run. But you've also had to pay the price of cumbersome coding.

With Microsoft® Macro Assembler version 5.1. you get ease and speed. Starting with our Mixed Language Programming Guide that teaches you how to call MASM subroutines from your high-

level programs. To the PROC directive that makes it as easy to pass parameters to an assembler subroutine as it is in high-level languages. Plus you get our easy-to-use "fill-in-the-blanks" template programs.

In addition to MS-DOS® support, MASM 5.1 has full MS<sup>®</sup>OS/2 support that lets you do things like break the 640K barrier, create multithreaded applications and Dynamic Link Libraries. And you get a complete set of high-octane development tools that lets you work faster under both environ-

ments. As well as the reconfigurable Microsoft Editor, a high-speed linker and new incremental linker for MS OS/2. And the renowned Microsoft CodeView® window-oriented source-level debugger that lets you blaze through debugging.

For the details. check the techbox. For more information, call (800) 541-1261, Dept. I17. And learn how today's new Microsoft MASM is so fast and easy it comes with the following offer.

The night off.

#### Microsoft Macro Assembler Version 5.1 for MS OS/2 and MS-DOS

## Mixed-Language Programming Support and

- Documentation Mixed-Language Programming Guide with step
- by-step examples.
- MASM templates for interfacing to BASIC, C, FORTRAN, and Pascal.
- Sample macros for interfacing for DOS and OS/2 systems. NEW!
- Simplified segment directives make writing MASM subroutines easy.
   Comprehensive instruction set reference with
- Programmer's Guide complete guide to MASM features and instruction set.

# Macro Assembler for MS OS/2 and MS-DOS • Full MS OS/2 support to break the 640K barrier

- NEW!
- Supports the 80386 and 80387 instruction set.
- Assembles 25-40% faster than MASM 4.0.

  Have labels local to a procedure. NEW!

  Declare stack based local variables within a pro-
- cedure, NEW! · OS/2 systems incremental linker - up to 20 times faster than a full link, NEW!

# Microsoft CodeView Window-Oriented Debugger

- And Microsoft Editor
   Full OS/2 systems support. NEW!
   Debug MASM code using original source code
- with your comments.

  Interactively view structures and chase linked lists. NEW!
- Take advantage of the 80386.
  Set dynamic breakpoints, watch variables,
- memory, registers and flags.
- MS OS/2 and MS-DOS reconfigurable programmer's editor. NEW!

© 1988 Microsoft Corporation. Microsoft, the Microsoft logo, MS, MS-DOS and CodeView are registered trademarks of Microsoft Corporation.



Hardware

Software

Compat-ibility

EMS 4.0

EEMS

EMS 3.2

OS/2

EMS 4.0

EEMS

**EMS 3.2** 

Computer

Model

AT or Com-

patible (XT form

RampagePlus/MC

RampagePlus 286

Memory

O Piggyback Modules

(optional)

Serial

Serial or

Serial/

**Parallel** 

Serial or

Serial

# RampagePlus From AST.

These days, to really get power, you've got to have a

Rampage. RampagePlus from AST—the most powerful memory/multifunction boards you can buy.

With RampagePlus/MC for your IBM® PS/2™ Model 50/60, or RampagePlus 286 for your AT® or compatible,

you can have: up to eight megabytes of memory. EMS 4.0 compatibility. OS/2™ compatibility. And, optional I/O piggyback modules. There's

nothing like them anywhere.

By making the one simple decision to buy Rampage-Plus, you can postpone making a lot of other decisions. If you're asking yourself: Do I need the extra functionality of EMS 4.0? Should I plan on converting to OS/2? Can I get the same power from my AT compatible as I can with a PS/2? Will I need to save slots for input/output boards? Ram-

pagePlus takes care of it all.

Of course, you'll be going on a Rampage designed by AST. That makes your decision even easier. After all, year after year, we've sold more memory/multifunction boards than any other company. Great boards, like SixPakPlus® and Advantage. And, after selling over three million boards, we're proud to say the RampagePlus boards are the best we've ever built.

For one, they are the first memory boards to offer 100% EMS 4.0 compatibility. RampagePlus 286 has 12.5 MHz speed designed especially for fast AT compatibles, while Rampage-

Plus/MC runs with zero wait-states to get the most out of your PS/2s. And, both RampagePlus boards include SuperPak™ AST's utility software programs.

Finally, there's one thing you'll find on a RampagePlus that you won't find on any other memory board, the AST name. And that means that you can make a safe decision and go on a Rampage, all at

the same time. To find out how, call AST, (714) 863-0181, Operator AA27, or send us the coupon.





# Times Have Changed.

| Yes, send me more inform ☐ Have an AST represen | nation on: $\square$ RampagePlus/MC $\square$ RampagePlus tative call me. |
|---|---|
| Name  |   |
| Title   | Phone ()  |
| Company   |   |
| CompanyAddress                                  |   |
| City/State/Zip                                  |   |
| Send to: AST Research, Inc                      | c., 2121 Alton Avenue, Irvine, CA 92714-4992, Attn: M.                    |

AST markets products worldwide—in Europe and the Middle East, call 44 1 568 4350; in the Far East, call: 852 5 717223; in Canada, call: 416 826 7514. AST, AST logo, Rampage, SixPakPlus and Advantage registered and SuperPak trademark AST Research, Inc. IBM and AT registered and PS/2 and OS/2 trademarks International Business Machines, Corp. Copyright © 1988 AST Research, Inc. All rights reserved.

# TEPCHINANO!

FOR SYSTEMS DEVELOPERS AND INTEGRATORS



OS/2's Dynamic Link

100

### COVER SUITE: SYSTEMS PERFORMANCE

Technology marches on and so must our ability to measure it. The latest and greatest 25-MHz 386 computers require new high-level benchmarks to give us a better idea of just how well they perform.

# Product reviews:

ALR FlexCache 25386

Compaq Deskpro 386/25 Everex Step 386/25 IBM PS/2 Model 70-A21



A New Twist for Ethernet

86

# ANNAFE DESIGN

Building up to IEW/WS

110

# **HIGH-LEVEL MEASUREMENTS**

KENT QUIRK

To keep up with advancing technology, *PC Tech Journal* has devised a new set of benchmarks for measuring systems performance. We describe our benchmarks here and provide full source and executable code on PCTECHline. Our benchmarks measure text scrolling, windowing, graphics, CPU speed and memory, computational speed, and disk operations. To put our benchmarks into context and set the stage for future tests, we run them on ten 286 and 386 systems from IBM and Compaq. You will find the results very telling.

54

### 100 MHz OF PERFORMANCE

DAVID CLAIBORNE and JIM SHIELDS

The world is getting faster all the time—witness the quartet of 25-MHz 386 machines released in the past few months. ALR, Compaq, Everex, and IBM are running their fastest race yet, and we set ourselves up around the track, clocking them with our new high-level benchmarks. Our results show them to be from four to seven times faster than an AT. Each machine aims for a slightly different group of users, and they all differ markedly in quality. And the winner is . . .

66

## SYSTEMS MAN



More often than not you will find senior technical editor Jim Shields with screwdriver in hand and head buried deep inside a system unit. He has been instrumental in guiding all of our systems reviews, and they just keep getting more complex. For this month's cover suite, Shields and

associate editor David Robb began a systems marathon several months ago, working with author Kent Quirk to update our benchmarks in order to handle the faster, more complex computers. Then with contributing editor David Claiborne, they surrounded themselves with 25-MHz power. For Shields, who has 20 years' experience in systems support and recently coauthored the *IBM PS/2 Technical Guide*, this is the way desktop computing was always meant to be.

| LOCAL AREA<br>NETWORKS   | SCREENMAKER-T may be   | DEPARTMENTS  |
|--|--|--|
| Ernowning Transf Elicogerous Philip N  | A NEW TWIST FOR ETHERNET  JOHN KOLMAN  It sounds like the perfect solution to all your cabling problems: the most popular LAN—Ethernet—running over the most abundant installed cable in America—telephone wire. | 15 LETTERS  EMS 4.0 exception;  Red-bot Macs.  |
| Por Haiths   | SynOptics and 3Com already have products that implement Ethernet on twisted-pair telephone wire at 10 Mbits per second.  | 36 TECH RELEASES  The Deskpro 386s and 386/25  from Compaq; NEC releases  its 20-MHz PowerMate 386;  |
| OPERATING<br>ENVIRONMENTS  | OS/2'S DYNAMIC LINK  MARY DEWOLF and TED MIRECKI  Developers will find strength and flexibility in OS/2's dynamic link libraries (DLLs), which add APIs to the operating system                                  | standard communications<br>programming interface from<br>Intel and leading software<br>developers; HP VGA; Progress<br>adds SQL support; and more. |
| genare she booker  | and allow code sharing. We build a sample DLL to illustrate the extensive capabilities of this important OS/2 feature.   | 127 PRODUCT WATCH Fastback Plus 1.0 Pro-C 1.1 MKS Toolkit 2.3  |
| APPLICATION DEVELOPMENT  Product review: KnowledgeWare's IEW/WS  | BUILDING UP TO IEW/WS ANDREW TOPPER Unlike most CASE tools, KnowledgeWare's IEW/WS combines the planning, analysis, and design phases of software development into one separate but integrated package.  110     | 137 TECH NOTEBOOK (1) The DOS boot process. (2) The OS/2 boot process. (3) Adding dual-boot capability to OS/2.                                    |
| MONTHLY COLUMNS  | SYSTEMS PERSPECTIVE  Measuring Performance/JULIE ANDERSON  Our philosophy has not changed, but our methodology has.  Our benchmarks have stepped up to a higher level.   | 152 TECH MART  155 TECH MARKETPLACE  166 INDEX TO ADVERTISERS  |
| Green Carbons, Columbia, MD  11-50c 51c 51c 51c 51c 50c  21-50c 51c 51c 51c 51c 51c  21-50c 51c 51c 51c  21-50c 51c 51c  21-50c 51c  21-50c  2 | NEW DIRECTIONS  Analyzing the Apple Suit/WILL FASTIE  We can't predict the outcome, but we can describe the various scenarios and their potential impact on developers.  23                                      | 167 INDEX TO PRODUCTS  168 PROFESSIONAL VIEWPOINT  Bad management and inadequate vendor support  |
|  | OUTFITTING THE END USER  A Shrink-wrapped Smile/PETER C. COFFEE  That "service with a smile" maxim is oft forgot in the sale of software. The transaction itself only begins the friendship.  145                | are worst LAN problems.  169 READER SERVICE CARD  Cover illustration · Lauren Uram   |

# CREATE PROFESSIONAL SCREENS IN MINUTES

# with SCREENMAKER-TIM

# A POWERFUL NEW SCREEN DESIGN UTILITY ALLOWING YOU TO

- Build your displays from scratch using our full feature "what you see is what you get" Screen Editor.
- Use our memory resident snapshot program to capture text displays from any running program for subsequent editing, including programs such as "Dan Bricklin's DEMO".

## Screen displays created through SCREENMAKER-T may be

- Included in your C or Pascal programs WITHOUT adding code, substantially reducing program size and mainte-nance, using our Binary Display to Text Data Structure
- Included in a text oriented slide show for use with our STANDALONE VIEWER and freely distributed using our SLIDESHOW EDITOR and COPIER programs.

### Using our Screen Editor is a snap and features include:

- Block copy, Move, Duplicate, or Delete
- Drawing Boxes or Freehand Lines with any of the ASCII or Extended ASCII Characters
- Entering Text in Four Directions
- Create / Edit Color Displays, even on a Non-Color Monitor.
- Change Colors by Block or with Cursor
- Keep Display Elements on a Scratchpad
- Specify and Reserve Data Input Areas
- Call up Help or Cancel Most Operations with one Keystroke
- Save and Edit Partially Completed Displays
- Build and Edit a Static Slideshow

The same efficient Libraries with over 75 routines used to write SCREENMAKER-T to maintain complete control over the display and keyboard are now available separately for the following compilers:

Turbo C (V1.0, 1.5) Microsoft C (V4.0, 5.0) Mix C (V1.0)

Aztec C (V3.2)

Lattice C (V2.1x)

Turbo Pascal (V4.0).

Programs require IBM PC/Compatible, MS-DOS 2.0 or higher and are EGA aware.

# SCREENMAKER-T

ONLY \$99.95

MD RESIDENTS ADD 5% SALES TAX





PO's accepted

CALL TODAY 1-800-848-8338

# MULTISYSTEM DEVELOPMENT, INC.

P.O. Box 1292 • Severna Park, MD 21146

Turbo C and Turbo Pascal are Registered Trademarks of Borland Int'l., Inc.; Microsoft C is a Registered Trademark of Microsoft Corp.; Lattice C is a Registered Trademark of Lattice, Inc.; Aztec C is a Registered Trademark of Lattice, Inc.; Aztec C is a Registered Trademark of Manx Software, Inc.; Mix C is a Registered Trademark of Mix Software; IBM PC is a Registered Trademark of IBM Corporation; MS-DOS is a Registered Trademark of Microsoft Corporation; Dan Bricklin's Demo is a registered trademark of Software Garden, Inc.



VOL. 6, NO. 9

PUBLISHER: Donald J. Byrnes EDITORIAL DIRECTOR: Will Fastie EDITOR: Julie Anderson

#### EDITORIAL

EXECUTIVE EDITORS: Susan Holly, David Methvin SENIOR TECHNICAL EDITOR: Jim Shields TECHNICAL EDITORS: Maxine Fontana, Ted Mirecki SENIOR EDITOR: Gail Shaffer ASSOCIATE EDITORS: David Robb, Jordene Zeimetz SENIOR COPY EDITOR: Bruce Ansley SENIOR COPY EDITOR: Bruce Ansley
COPY EDITOR: Judith Estrin
EDITORIAL PRODUCTION ASSISTANT: Katherine M. Kiwak
NEW PRODUCTS EDITOR: Carole Eyring
LAB TECHNICIAN: Todd Bannar
EDITORIAL ASSISTANT: Barbara Smith
BUSINESS MANAGER: Trish Ledbetter
EDITORIAL SECRETARY: Beth Sauberlich
RECEPTIONIST: Tobie J. Ketterer
CONTRIBUTING EDITORS: Sleven Armbrust, Dave Browning, David
Claiborne, Peter C. Coffee, Richard M. Foard, Ted Forgeron, Philip N.
Hisley, Thomas V. Hoffmann, Max Stul Oppenbeimer

#### ART AND PRODUCTION

ART DIRECTOR: Sbaron Reuter
ASSOCIATE ART DIRECTOR: Courtney Barone
ASSISTANT ART DIRECTOR: Crystal Hopkins
ART ASSISTANT: Cheri Glover
PRODUCTION MANAGER: Alison Regan Mrobs
CONTRIBUTING ARTISTS: Maciek Albrecht, David Povilaitis

#### ADVERTISING SALES

ADVERTISING SALES

NATIONAL ADVERTISING DIRECTOR: Rita Burke
NATIONAL TELEMARKETING MANAGER: Arlene Braithwaite
MARKETING DIRECTOR: Marti Cunha
ASSISTANT MANAGER OF MARKETING: Kimberly Schroeder
ASSISTANT TO THE PUBLISHER: Lucy Frazer
MARKETING ASSISTANT: Debbie Lintner
SALES SECRETARY: Mary Barrow
DISTRICT MANAGERS: Bill Barney-Southeast and Eastern Canada; Melinda
Magimn-New England; John Blake-Mid-Atlantic; Stephen Dress-Midwest;
Gayl Sorota, Elaine Ehner-West Coast
ACCOUNT REPRESENTATIVES: Mary Martin-Southeast and New England;
Namnette Vilushis-Midwest and Mid-Atlantic; Classified Advertising
Director-Kathryn Cumberlander

#### CIRCULATION

SUBSCRIPTION DIRECTOR: Paul Stafford SINGLE-COPY SALES DIRECTOR: Robert Woltersdorf

## GROUP VICE PRESIDENT: J. Scott Briggs ZIFF-DAVIS PUBLISHING COMPANY, a division of Ziff Communications Co.

ZIFF-DAVIS PUBLISHING COMPANY, a division of Ziff Comm PRESIDENT: Kenneth H. Koppel GROUP VICE PRESIDENTS: J. Scott Briggs, William Lohse SENIOR VICE PRESIDENT, Marketing: Paul H. Chook VICE PRESIDENT, Operations: Baird Davis VICE PRESIDENT, Controller: John Vlachos VICE PRESIDENT, Creative Services: Herbert Stern VICE PRESIDENT, Creative Services: Herbert Stern VICE PRESIDENT, Classified Advertising: Alicia Marie Ivans VICE PRESIDENT, Circulation: Bert Lacy VICE PRESIDENT, Circulation Services: James Ramaley VICE PRESIDENT, Marketing Services: Ann Pollak Adelman VICE PRESIDENT, Development: Seth Alpert VICE PRESIDENT, Production: Roger C. Herrmann DIRECTOR OF PLANNING: Gary A. Gustafson PRODUCTION DIRECTOR: Walter J. Terlecki

#### ZIFF COMMUNICATIONS COMPANY

CHAIRMAN: Philip B. Korsant; PRESIDENT: Kenneth H. Koppel; EXECUTIVE VICE PRESIDENT: Stephen C. Kabler; SENIOR VICE PRESIDENTS: Philip Sine, Hugh Tietjen; VICE PRESIDENTS: William L. Phillips, J. Malcolm Morris, Steven C. Feinman; SECRETARY: Bertram A.

#### EDITORIAL OFFICE

PC Tech Journal, Suite 800, 10480 Little Patuxent Parkway, Columbia, MD 21044-3506; 301/740-8300. FAX (group 3): 301/740-8809. MCI Mail: PCTECH. PCTECHline: 301/740-8383 (2400/1200/300 bps, 8 data bits, 1 stop bit, no parity). Telex: 6502565932 MCI.

### ADVERTISING OFFICES

Corporate/Southeast/Canada: Suite 800, 10480 Little Patuxent Parkway, Columbia, MD 21044-3506; 301/740-8300. New England: 144 Watching Avenue, Upper Montclair, NJ 07043; 201/509-8148. Mid-Atlantic: 89 Pearsall Place, Merrick, NY 11566; 516/546-7505. Midwest: Suite 1400, 180 N. Michigan Avenue, Chicago, IL. 60601; 312/346-2600. West Coast: 3460 Wilshire Blvd., Los Angeles, CA 90010; 213/387-2100. 110 Marsh Drive, Foster City, CA 94404; 415/378-5580.

#### SUBSCRIPTION INQUIRIES

FOC Tech Journal, P.O. Box 2968, Boulder, CO 80321. Subscription service: 303/447-9330. For back issues (subject to availability) send \$7.00 per copy, \$8.00 outside U.S. (\$7.95/\$9.95 for 1988 Directory issue only) to: Ziff-Davis Publishing Company, P.O. Box 5999, Cherry Hill, NJ 08034, Atm: F. Hunter; 609/354-4975.

P.C. Tech Journal (ISSN 0738-0194) is published monthly by Ziff-Davis Publishing Company, a division of Ziff Communications Company, One Park Avenue, New York, NY 10016. Subscription rate is \$34.97 for one year (12 issues). Additional postage for Canada and Foreign is \$10.00 per year. Second-class postage paid at New York, NY, and at additional mailing offices. POSTMASTER: Send address changes to PC Tech Journal, P.O. Box 55761, Boulder, CO 80321 CO 80321.

PC TECH JOURNAL is an independent journal, not affiliated in any way with International Business Machines Corporation. IBM is a registered trademark of International Business Machines Corporation. Entire contents Copyright © 1988 Ziff-Davis Publishing Company, a division of Ziff Communications Company, All rights reserved; reproduction in whole or in part without permission is prohibited. Direct written requests to Jean Lamensdorf, Licensing Manager, One Park Avenue, New York, NY 10016.



# Periscope's New Version 4

**Gives you all the right stuff for debugging! No** matter which model you pick, you have the same powerful software to help you track down hard-to-find bugs fast.

David Nanian, President of Underware, Inc. (of BRIEF fame) says this about the new Periscope Version 4:

'Periscope has always been an unbelievable assembler-level debugger. Version 4 has turned it into a terrific source-level debugger as well. Aside from major enhancements like the source-level improvements, all the little changes make a really big difference, too. For instance, symbol lookups and disassemblies are noticeably faster, and highlighting the registers that have changed really makes life easier. Once again, Periscope has raised the industry standard for debuggers!'





Periscope's software is solid, comprehensive, and flexible.

It helps you debug just about any kind of program you can write...thoroughly and efficiently

Periscope's the answer for debugging device-drivers, memory-resident, non-DOS, and interrupt-driven programs. Periscope works with any language, and provides source and/or symbol support for programs written in high-level languages and



Periscope's hardware adds the power to solve the really tough debugging problems.



Periscope Break-out Switch

The break-out switch lets you break into the system any time. You can track down a bug instantly, or just check what's going on, without having to reboot or power down and back up. That's really useful when your system hangs! The switch is included with Periscope I, Periscope II, and Periscope III.

Periscope I has a board with 56K of write-protected RAM. The Periscope software resides in this memory, safe from runaway programs. DOS memory, where debugger software would normally reside, is thus freed up for your program.

Periscope III has a board with 64K of write-protected RAM, which performs the same function as the Periscope I protected memory. AND.

The Periscope III board adds another powerful dimension to your debugging. Its hardware breakpoints and real-time trace buffer let you track down



bugs that a softwareoriented debugger would take too long to find, or can't find at all!

minimum minimum

Periscope I Board

Periscope III Board

# What's New in Periscope **Version 4:**

- View local symbols from Microsoft C (Version 5)
- Debug Microsoft windows applications
- Set breakpoints in PLINK overlays
- Improved source-level support
- Monitor variables in a Watch window
- 80386 debug register support
- · Debug using a dumb terminal
- PS/2 watchdog timer support
- Use mixed-case symbols
- · Set breakpoints on values of Flags
- Much more!
- Periscope I includes a half-length board with 56K of write-protected RAM; break-out switch; software and manual for
- Periscope II includes break-out switch; software and manual for \$175.
- Periscope II-X includes software and manual (no hardware) for \$145.
- Periscope III includes a full-length board with 64K of write-protected RAM, hardware breakpoints and real-time trace buffer; break-out switch; software and manual. Periscope III for machines running up to 10 MHz is \$1395.

REQUIREMENTS: IBM PC, XT, AT, or close compatible (Periscope III requires hardware as well as software compatibility); DOS 2.0 or later; 64K available memory; one disk drive; an 80-column monitor.

Call us with your questions. We'll be happy to send you free information or help you decide on the model that best fits your needs.

Order Your Periscope, Toll-Free, Today! 800-722-7006

MAJOR CREDIT CARDS ACCEPTED



1197 PEACHTREE ST. • PLAZA LEVEL ATLANTA, GA 30361 • 404 / 875-8080

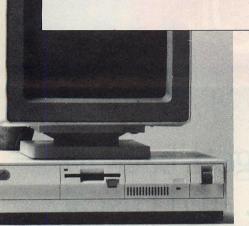


Here's a radical idea: give people who work together the means to easily share information among PCs—but don't force them to become computer experts

Here's another one. Make this network so simple to install that you can set up the whole thing in oh, say, a half hour or so.

Presenting TOPS.

# MORE NETWORK. LESS NET WORK.



With the TOPS Network, you and your co-workers can access files from each other's computers exactly as if they were sitting on your own PC or hard disk. And even print out those files (with our TOPS NetPrint™ software) directly to any printer that supports the "PostScript" language, such as Apple's LaserWriter.™ All through easy-to-use menu commands.

The result is the very comforting—and productive—feeling of being able to concentrate on the work at hand, instead of on having to learn the network.

On a TOPS Network, every computer can share files directly with any other, thereby sharing the load of the entire network. The result is that you don't have to purchase an expensive central file server. Or shut down the network when you want to add a new computer. Or hire an extra person to manage the whole affair.

And setting up TOPS is just as straightforward. You can install the necessary network card—such as our TOPS FlashCard™—in no more than twenty minutes. Loading the TOPS software? We've unofficially clocked it under five minutes.

As if all that weren't enough, TOPS runs over common twisted-pair cabling, such as regular phone wire. Just add an easy-to-install network connector — such as the TOPS TeleConnector—at each node. And at only \$189 for the software, and \$239 for each TOPS FlashCard, TOPS is the least expensive way to get your workgroup working together.

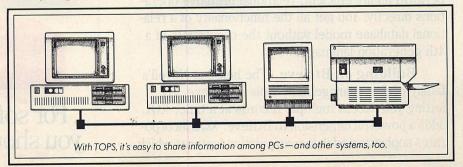
Of course with TOPS, PC-to-PC communication is just the beginning. Because without sacrificing simplicity, we also offer products that let you share information just as easily with other networks and systems, including Macintoshes™and Sun\* workstations.

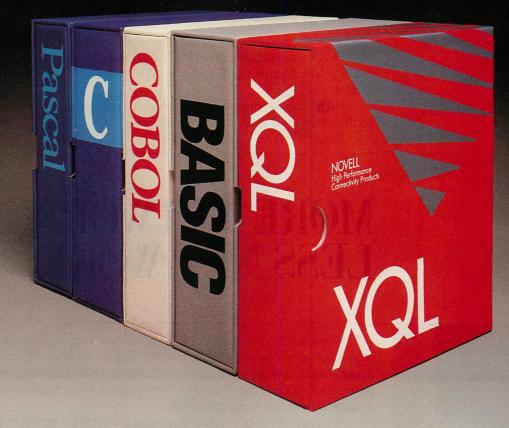
Want more information? Give us a call at 800-445-TOPS (from outside the U.S. and Canada, call 415-769-8700). Or write to us at TOPS, 950 Marina Village Parkway, Alameda, California 94501.

After that, it gets easier.

A Sun Microsystems Company

TOPS, Sun, and the Sun logo are registered trademarks of Sun Microsystems, Inc TOPS FlashCard and TOPS NetPrint are trademarks of Sun Microsystems, Inc PostScript is a registered trademark of Adobe Systems Incorporated. Macintosh and LaserWriter are trademarks of Apple Computer, Inc.





# Finally, there's an SQL that gets back to BASIC. And COBOL. And C. And Pascal.

As a programmer, you've probably already faced it—the database dilemma. Do you use an SQL for easy database handling, or a true programming language for maximum power and flexibility?

Now you can do both with XQL, the relational data management system from the developers of Btrieve.

The Programmer's SQL. With XQL, you can access your data with the ease of Structured Query Language through simple subroutine calls from traditional programming languages. XQL supports standard SQL syntax, including subqueries, unions and security groups.

**XQL Relational Primitive Operations.** 

In addition, XQL lets you bypass the SQL level and perform highly efficient, relational primitive operations directly. You get all the functionality of a relational database model without the constraints of a 4th generation language.

Building on Btrieve. The heart of Novell's family of data management tools is Btrieve. By letting you access multiple records at a time, XQL adds a powerful dimension to Btrieve. XQL incorporates sophisticated data manipulation features which

allow you to access data by field name, move forward or backwards through the database, compute fields from other fields or constants, and even work with composite records built from multiple, joined Btrieve files.

Like Btrieve, XQL offers features like multiuser support, fault tolerance, comprehensive documentation, and expert technical support. And you never pay royalties on your XQL applications.

Solve the database dilemma with XQL, the SQL that speaks your language. Only \$795.\* See your Authorized Novell Gold Reseller, or call us at (512) 346-8380.

For more information, call from your modem 1-800-444-4472 (8 bit, no parity, 1 stop bit) and enter the access code NVXQL3.



For software solutions, you should be seeing red.

# Systems Perspective

# Measuring Performance

As machines continually improve, so must the methods of measuring their performance.



About a year ago, we realized that our system benchmarks were slipping quickly into obsolescence. Since that time, we have been working to create the revised benchmarks presented in this month's cover suite. Although our philosophy has not changed, our methodology has.

Our underlying philosophy is simple: overall performance of a computer system is determined by the individual performance of its five basic components: central processor, memory, video, disk, and math coprocessor. Benchmarks, therefore, should be designed to assess the maximum performance possible from each of these five basic components.

Our readers who are developing custom applications then can extrapolate from these results to determine which computer system will run their application the best; they understand how heavily the performance of each system component influences the performance of their application.

Systems integrators also can benefit from the benchmarks. For example, when choosing a LAN server, the integrator will want to find a system with high-performing CPU, memory, and disk systems; peppy video on a LAN server is not essential.

### **OUT WITH THE OLD**

To understand our new methodology, it helps to look at the old one. *PC Tech Journal*'s original system benchmarks, introduced in 1986, measured performance of AT-class machines at the hardware level. The tests returned numbers on CPU and math coprocessor clock rates, RAM and video memory read and write times, wait states, average access time on a disk, and effective disk data-transfer rate.

Consistent with our philosophy, we intentionally steered away from running commercial applications. For our readers who are developing cus-

tom applications, performance numbers on Ashton-Tate's dBASE, Lotus 1-2-3, or other off-the-shelf applications would be meaningless. Without source code, how do you determine how and in what proportions a commercial application is using computer resources such as memory, CPU, and disk.

Further complicating matters, commercial applications continually are reincarnated into new releases that perform differently than the old versions, thus thwarting the goal of benchmarking, which is to compare the performance of one system against another previously measured system.

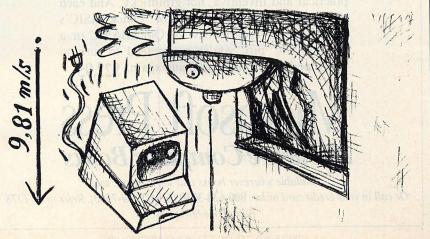
### IN WITH THE NEW

Faced with evolving architectures, we were racing to create new benchmarks even as we were updating the old ones. Machines based on the 386 were rapidly sprouting up in the market-place, each architecturally different from the one before until a significant evolution occurred: subsystems replaced single components. ESDI controllers with full-track buffering are now paired with disk-caching software to improve disk performance. As a result, average access time is no longer as significant as it was when every read request meant another trip to the disk.

Memory-caching hardware brought with it similar complications. RAM read and write times vary widely depending on whether or not the contents of the target address are in the cache. We realized that to measure the performance of the new subsystems, we had to rewrite the benchmarks at a higher, more hardware-independent level.

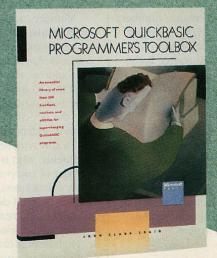
To this end, senior technical editor Jim Shields, who is responsible for our coverage of computer systems and add-in components, enlisted the expertise of a talented developer, Kent Quirk, to help create our new set of system benchmarks, which we present in "High-level Measurements" on page 54. In this first article, Kent Quirk explains how the new evaluation suite, HLBENCH, works. We also publish performance numbers for ten 286 and 386 machines, including IBM's PC/AT and PS/2 models and Compaq's Portable and Deskpro computers.

Besides stepping one level up, HLBENCH has a valuable new feature: it can compare the performance of any two computers. HLBENCH does this by saving the performance data for each machine tested. The data can then be retrieved and graphed against the performance results of the machine currently being tested. Full source and



TISTRATION • MACIFK ALBRECHT

# QuickBASIC Supercharged!



Want even more power, speed, and creativity out of your QuickBASIC programs? Here's THE MICROSOFT® QUICKBASIC PROGRAM-MER'S TOOLBOX—an essential library of more than 250 subprograms, functions, and utilities designed to supercharge your QuickBASIC programs. The subprograms and functions created by author John Clark Craig address: ANSI.SYS screen control ■ mouse support ■ pop-up windows ■ graphics ■ string manipulations ■ bit manipulation ■ editing routines ■ engineering, mathematical, and statistical functions game programming ■ interlanguage calling ■ and more. Each is practical and inventive, not gimmicky. And each takes maximum advantage of QuickBASIC's capabilities. If you're new to QuickBASIC or a QuickBASIC pro, you're guaranteed to turn to this superb collection again and again. \$22.95

# Microsoft Press Hardcore Computer Books

Available wherever books and software are sold.

Or call in your credit card order. 800-638-3030 (In MD 824-7300). Refer to ad TJ78.

Book Code 86-96403.

### SYSTEMS PERSPECTIVE

executable code for HLBENCH, as well as the performance data for 14 machines, is available for downloading on PCTECHline, 301/740-8383.

In the second article of our cover suite, "100 MHz of Performance," David Claiborne and Jim Shields review 25-MHz 386 machines from ALR, Compaq, Everex, and IBM. We call these four machines the "ultimate desktop computers," a name that should endure at least until the next generation of ultimate desktop machines arrives. Although technically they are desktop computers, we found that not all of them are designed to sit on a desk. Some are better suited for the LANserver closet. (This month's reader opinion card asks how you would use a 25-MHz machine.)

Certainly as important as measuring performance is understanding why one machine performs better than another. For example, all four 25-MHz machines feature memory caches. All memory caches, however, are not created equal. Cache performance depends on how much memory is in the cache, the speed of the memory chips, and the caching algorithm used.

In both articles, we not only measure performance, we also analyze the results of the benchmarks, pointing out why one machine gains an advantage over another. Understanding how each subsystem is designed allows a developer to tailor an application to exploit the machine's power.

### **MAC COVERAGE**

The preliminary returns on our reader opinion card for July reveal that I may have unwittingly misled readers about our future plans for Mac coverage. Many readers responded emotionally, fearing that *PC Tech Journal* would devote too many pages to the Mac. I assure you this is not in our plans.

We wrote the cover suite to help those who faced integration problems with Macs and PCs cohabitating in the same work environment. This coverage is no different from any we have done in the past on 3270 or 5251 connections. We also have no plans to cover IBM mainframes or minicomputers except as they relate to PCs.

Two positive responses from Mac-PC integrators are printed in this month's Letters column beginning on page 15, and a full report on the reader opinion card responses will appear in Professional Viewpoint next month. Meanwhile, rest assured that we remain *PC Tech Journal*.





# IAIL

Wait for Ashton-Tate to get their SQL act together. In the meantime, just sit here and watch the ORACLE players pass you by. Or order Professional ORACLE today. The \$199 price expires on September 30th.

# ORACLE® Gives Your PC a Monopoly

- 66 ORACLE's top guns make dBASE look like a peasbooter."
  - Data Based Advisor, June 1988
- **65** If it isn't in ORACLE, it probably isn't in anything else, either... For readers who want it all, this is the product to buy."

Software Digest, September 1987

66 Professional ORACLE is the program of choice for those who want sophisticated forms, reports, and SQL capabilities without having to program extensively."

Software Digest Ratings Report, Advanced Relational Database Programs, September 1987

- A robust, full-blown mainframe database that will run on a micro...

  ORACLE will crunch data until your eyes roll back in your head."

  Infoworld, April 1988
- **66** Well constructed and powerful, Professional ORACLE is an excellent choice for... application developers."

Winner, Editor's Choice, PC Magazine, May 1988



66... provide(s) applications developers with unlimited power... Security provided by [ORACLE] on the single-user PC is as extensive as it is on the largest mainframe..."

PC Tech Journal, December 1987

The experts agree. When you buy the ORACLE database for your PC, you acquire several important ORACLE monopolies.

COMPATIBILITY: ORACLE is SQL, compatible with IBMs DB2 and SQL/DS. PORTABILITY: It's the only RDBMS that runs on mainframes, minis and PCs. CONNECTABILITY: It's network ready with the unrivalled ability to make different databases on different machines — mainframes, minis and micros — appear to be one database on one machine. Finally, PRICE: Tens of thousands of copies of ORACLE for the PC have sold for \$1295. But until September 30th, 1988 you can see what made Oracle Corporation the world's largest database company, and what has the experts so excited.

Pass GO and collect Professional ORACLE for only \$199.\* Or go to JAIL with some really old technology.

COMPATIBILITY · PORTABILITY · CONNECTABILITY

Call 1-800-ORACLE1, ext. 148 or an ORACLE MasterVAR today.

GO TO













# GO ORACLE

PC ORACLE OFFER • Oracle Corporation 20 Davis Drive • Belmont, California 94002

- 20 Davis Drive Belmont, California 9400

  ☐ Enclosed is my business card or letterhead.
- | Description of the control of the
  - \$\_\_\_\_\_\_ for Professional ORACLE
    - Please add appropriate sales tax

      TOTAL enclosed or authorized
- Credit Card #

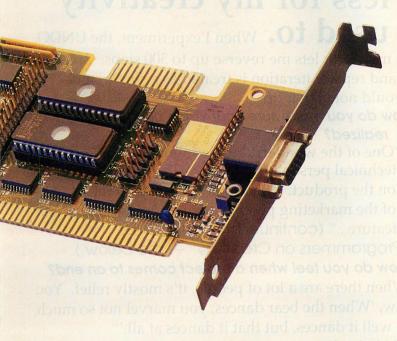
Exp. Date

gnature \_\_\_\_\_ Ces valid in the united states only **PCTECHJOUR** 





# less.



You don't have to wait for complete compatibility, either. Not only are both FastWrite VGA and V-RAM



FastWrite VGA \$599

VGA 100% register level compatible but they're the only VGA cards that are form-factor compatible. They have the same daughter card connectors as the IBM PS/2 Display Adapter to accommodate hardware add-ons in the future.

There's more. Once you buy a Video Seven Display Adapter, we won't leave you hanging. You get free tech-

nical support, guaranteed VGA compatibility and a full five year warranty. All for a very down-to-earth price.

So don't wait another nanosecond. Visit your favorite dealer and find out more about FastWrite VGA and V-RAM VGA. Then get a grip. Because once you see what they can do, you're going to be walking on air.



Video Seven Inc., 46335 Landing Parkway, Fremont, CA 94538, (415) 656-7800

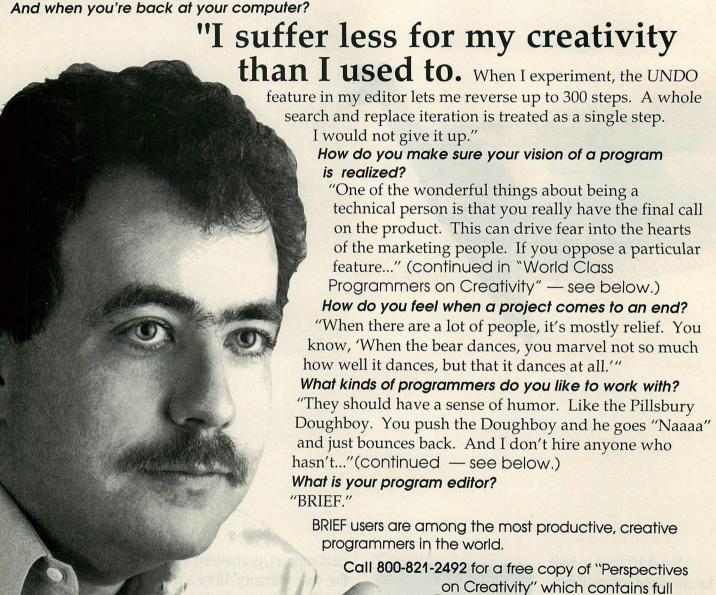
Display Adapter, International Business Machines Corporation; Variable frequency monitor required for greater than 640 x 350 resolution. Video Seven reserves the right to change specifications without notice.

# **World Class Programmers** on Creativity

Dan Sevush. Project Leader on Lotus 1-2-3. Principal Engineer on Agenda. Author of Speedup.

# How do you overcome a creative block?

"I keep a music synthesizer within pounding range. I'll improvise while I do low-level work. I can loosen up by letting my hands wander on the keyboard. Sometimes I experiment with "programming" the sounds — like, What does a piano sound like if it's bowed and played underwater in a glass dome?"



flexibility and power.

541 Main Street, Suite 410 S. Weymouth, MA 02190 (617)337-6963 CIRCLE NO. 130 ON READER SERVICE CARD

transcripts of interviews with Dan Sevush and five other leading programmers, including Wayne Ratliff and Bob Frankston, We'll also send you proof of BRIEF's

# LETTERS





### **EMS ADDENDUM**

I read your article on EMS 4.0 with great interest ("EMS 4.0 Pulls Together," Ted Mirecki, July 1988, p. 72). It raised many points that we at Newer Technology have been trying to bring to the public's attention.

However, I would like to take exception to the statement, "No boards currently on the market support any DMA registers or more than two sets of CPU registers." There is indeed an EMS 4.0 board with multiple CPU registers and DMA registers—the Newer Technology Concentration board, which has been on the market for nine months.

Roger Kasten Jr. Newer Technology Wichita, KS

### **EYEING THE MAC**

The following two letters were sent as additions to the reader opinion card (bound in the June 1988 issue between pages 8 and 9) that asked the questions: "How does (or will) your company use the Apple Macintosh?" and "Which of these applications require PC-Mac connections?" —JA

Regarding your questions about your readers' response to the Macintosh, all I can say is: "Why did you wait so long?" We in our company's information center have been battling/integrating the Mac into our solution strategies for at least a year now.

We desperately need the technical expertise to handle file interchange between the PC and the Mac. For example, we have been searching for a product to help move MacDraw files between the Mac and any product on the PC for over a year; none is yet available. We think Adobe's encapsulated PostScript (EPS) may end up being the best go-between for graphics.

We also need information on internetworking products. Comparisons of 3Com, Novell, TOPS, and AppleShare

would be very useful. Don't apologize for covering Apple Macs, just hit us with the best technical coverage possible for our changing environment.

You will always have a few soreheads that would like everything to remain the same, but we know that our lot is the agent of change, not the stifler. I remember sitting in a Radio Shack computer-users group back in 1981, and one person stood up to claim he would be leaving the group to start another one based on IBM personal computers. He received catcalls and hisses. The rest of us quiet folks proceeded to go out and buy a real computer—the IBM PC. The Macintosh is no less a real computer now that it has sufficient memory to run real applications and an open architecture.

> Gary Gunnerson Gannett Company Inc. Arlington, VA

Macs are getting to be a *very* hot issue: for us, as for you, they are "a presence we cannot ignore." I welcome *PC Tech Journal*'s realization of the importance of the Mac, specifically with issues relating to integration.

To answer your first question on how our company will use the Macintosh, our only "official" Mac application at the present is desktop publishing. We originally had selected Ventura Publisher on PCs as our standard, but the high level of compatibility across software products and the excellent graphics tools available on the Mac changed our minds.

Unofficially, Macs are creeping in for use as personal productivity tools. I have noticed that recent college graduates, in particular, have a Mac bias. Our company presently is discouraging general Mac use for some very good reasons, but I'm beginning to feel a lot like the kid with his finger in the dike.

As for which of our applications require PC-Mac connections, very few

of them *require* these connections, any more than a PC is "required" for most other purposes. For our company—and for many others I am sure—the real questions are: Who wants it? How much does it cost? Can we afford it? I would guess that the majority of our computer-related purchases are made because of *desire* and financial stability rather than *need*.

All of our applications will eventually "require" connectivity in the sense that access to a limited number of high-quality input and output devices will be desired and that electronic integration of documents from multiple sources will become increasingly important. The PC-Mac link is just one part of our general connectivity problem, but surely a necessary one.

One minor beef. In Julie Anderson's column "Mac Comes to Town" (Systems Perspective, July 1988, p. 9), first she states that 20 percent of the readers indicate Macs have infiltrated their company, a number that "we cannot ignore," but later in the column she justifies the focus on integration rather than development because "only" 15 percent of the readers are developing on the Mac. Either both numbers are significant, or neither is.

Please do not lose sight of one of your primary (and one of my favorite) goals: systems development.

Keith R. Spitz CH2M Hill Bellevue, WA

#### FREE THE DATA STRUCTURES

I am writing this letter to request a "Freedom of Information Act" for software data structures. As a software developer and consultant, I am called upon frequently to aid individuals who are converting one software package to another. The problem is that very often it is difficult or impossible to obtain the data structure of the original software package.

SEPTEMBER 1988

# Four ways to build better C programs...

# **LETTERS**

# NEW' POWER SCREEN \$129

Screen I/O manager.
Features: ♦ screen painter ♦ virtual screens

- ◆ data validation ◆ context sensitive help
   ◆ unlimited screens ◆ definable keys
  - ♦ & much more!

# C TOOLS PLUS \$129

Full featured function library.

◆ For Microsoft C 5.0 and QuickC.

Features: ◆ TSR support ◆ direct video access

◆ VGA and EGA support ◆ windows and menus ◆ DOS memory allocation ◆ interrupt service routines ◆ & much more!

# C ASYNCH MANAGER \$175

Asynchronous communication manager.
Features: ♦ speeds to 19.2K baud
♦ XON/XOFF protocol ♦ hardware
handshaking ♦ XModem file transfer ♦ I/O
buffers up to 64K ♦ & much more!

# TURBO C TOOLS \$129

Full featured function library. For Borland's Turbo C.

Features: ◆ TSR support ◆ direct video access ◆ VGA and EGA support ◆ windows and menus ◆ DOS memory allocation ◆ interrupt service routines ◆ & much more!

We're Blaise Computing, manufacturers of high quality function libraries designed to reduce the time and technical expertise required for serious applications development.

All of our packages include a comprehensive user reference manual with extensive examples, and sample programs. Satisfaction guaranteed or return within 30 days for a full refund.

We have a full line of products for  ${\rm C}$  and Pascal. For a free brochure or to order call

800-333-8087!

# BLAISE COMPUTING INC.

2560 Ninth Street, Suite 316 Berkeley, CA 94710 (415) 540-5441 CIRCLE NO. 102 ON READER SERVICE CARD I was asked recently to help a physician convert from one medical billing and insurance program, sold by one of the largest companies in the United States, to a package from a different vendor. The physician has used the original program for several years and had accumulated several thousand patient accounts in the system.

A colleague and I both contacted the vendor and requested a map of the program's data structure; we did not request source code or any proprietary information and we were willing to pay any necessary costs. Our request was firmly refused. Needless to say, the resulting data conversion was difficult and expensive and involved a great deal of manual reentry of data.

In speaking with other consultants and dealers who sell to users in other fields, I find that this scenario is the norm, not the exception. The policy of proprietary data structures is almost universal in accounting, medical, dental, job costing—in fact, in almost any so-called "vertical" market software currently available. This policy is detrimental to users, while catering to the pocketbooks of vendors.

When you stop to analyze the issue, you realize that furnishing data structures in no way can jeopardize the proprietary interests of a software developer. The data structure is useful only to people who have already purchased the program and generally does not provide much usable information as to the inner workings of the program code itself. Although vendors may fear losing their after-market income if existing users abandon them, they should stop to realize that they may in fact gain users who would convert from competing systems if data structures were universally available.

Furthermore, the ready availability of data structures enables third parties to produce add-in or enhancement products that improve the usefulness of the parent software—witness the wealth of add-in and enhancement products for Lotus 1-2-3 and dBASE. Every time these products are advertised, they endorse their parent products.

I can understand a vendor's fear that releasing the data structure might encourage the development of clone products, but aside from truly general-purpose programs such as 1-2-3 and dBASE, a clone maker has little to gain by preserving the original program's data structure in that data are not usually shared between original and copycat programs in these environments.

In a nutshell, vendors have little to lose and everything to gain by making the availability of software data structures universal. As was learned in the mainframe and minicomputer world, data structure availability is a mandatory prerequisite for the purchase of *any* software that has a major impact on a user's financial survival.

I think that the time has come for all software vendors to furnish data structures with their programs. As more and more people become increasingly dependent on computers for storing their vital data, they should have free access to that data. Even the most wonderful program might become obsolete next year, and even the largest vendor may be out of business next week.

For these reasons, I strongly advise individuals who are considering the purchase of software that could have a major impact on their lives to demand that the data structure of the program be furnished at the time of purchase. These individuals may not be programmers, but if they need to convert to a different program in the future, they will pay programmers far less if the data structure is already available. I also urge the major computer magazines to include the furnishing of data structures as a major criterion in their review of new and existing programs. Only then will we truly have freedom of information.

> Evan P. Provisor, M.D., president Epsoft Computer Systems Inc. Sharon. CT

### **SPEAKING OF LANGUAGES**

I would like to add some comments on the C language controversy addressed in the Professional Viewpoint column of your May issue (Jordene Zeimetz, p. 186). The survey that asked readers, "Does C meet your needs as a programming language?" returned a 70 percent response from satisfied C users. When you consider that *PC Tech Journal* is directed at systems programmers, and that readers who are unfamiliar with C did not bother to respond to the survey, the figure of 70 percent is low.

Reading between the lines, it is clear that for systems work, C has no competition, yet 27 percent of those using it were not satisfied. This is a far more significant statistic. I am sure that if you asked BASIC programmers doing applications work whether they were satisfied, no more than 5 percent would say no.

# WINDOWS FOR DATA®

MULTI-LEVEL
MULTI-LEVEL
MENU SYSTEM
MENU SYSTEM
NESTED FORMS
POP-UP FORMS
POP-UP FORMS
REGION
CHOICE LIST

Print INVOICE Invoice No.: 12/03/87 Date: Time: -Customer Search for customer record? (Y/N): N William Jones Innovative Software Enter customer information? (Y/N): Enter billing address? (Y/N): 351 Bulletin Avenue Enter marketing information? (Y/N): Needham, MA (617) 394-5512 DESCRIPTION QUANTITY PRICE **AMOUNT** No. PRODUCT **WDMS** Windows for Data Microsoft 295.00 2950.00 295.00 1475.00 **WDLA** 295.00 Windows for Data Turbo C 1590.00 WDXE Windows for Data 795.00 0.00 00.0 MDXE Subtotal: 11325.00 Windows for Data - XENIX Windows for Data - 3B2 Unix WD3B2 Shipping: Windows for Data - Sun Unix WDSII2 Windows for Data - MicroVax TOTAL 11325.00 **WDVM3** WDVM4 Windows for Data - Vax 780 Payment : 0.00 Cursor keys scroll, ENTER selects and ESC exits choice menu

POP-UP WINDOW RUNNING RUNNING TOTALS MESSAGE WINDOW

f you program in C, take a few moments to learn how Windows for Data can help you build a state-of-theart user interface.

- ✓ Develop window-based OS/2 programs right now, without the headaches of learning OS/2 screen management. Run the same source code in PCDOS and OS/2 protected mode.
- Build a better front end for any DBMS that has a Clanguage interface (most popular ones do).



### FROM END TO BEGINNING

Windows for Data begins where other screen packages end, with special features like nested pop-up forms and menus, field entry from lists of choices, scrollable regions for the entry of variable numbers of line items, and an exclusive built-in debugging system.

## NO WALLS

If you've been frustrated by the limitations of other screen utilities, don't be discouraged. You won't run into walls with Windows for Data. Our customers repeatedly tell us how they've used our system in ways we never imagined — but which we anticipated by designing Windows for Data for unprecedented adapatability. You will be amazed at what you can do with Windows for Data.

### YOU ARE ALWAYS IN CHARGE

Control functions that you write and attach to fields and/or keys can read, compare, validate, and change the data values in all fields of the form. Upon entry or exit from any field, control functions can call up subsidiary forms and menus, change the active field, exit or abort the form, perform almost any task you can imagine.



# OUR WINDOWS WILL OPEN DOORS

Our windows will open doors to new markets for your software. High-performance, source-codecompatible versions of Windows for Data are now available for PCDOS, OS/2, XENIX, UNIX, and VMS. PCDOS

versions are fully compatible with Microsoft Windows. **No royalties**.

### **MONEY BACK GUARANTEE**

You owe it to yourself and your programs to try Windows for Data. If not satisfied, you can return it for a full refund.

Prices: PCDOS \$295, Source \$295. OS/2 \$495. XENIX \$795. UNIX, VMS, please call.

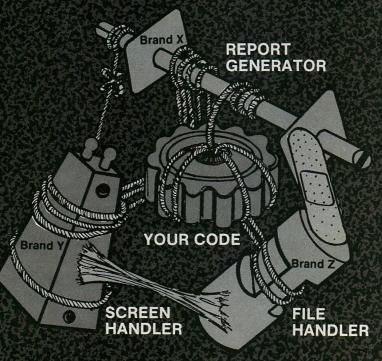
Call: (802) 848-7731 Telex: 510-601-4160 VCSOFT ext. 21

FAX 802-848-3502

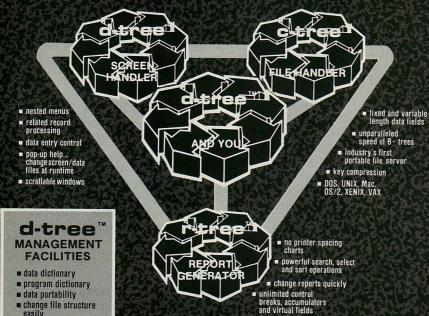


21 Elm Ave. Richford, VT 05476

# Quit tinkering around...



# ...and get in gear.





UNIX/AT&T, XENIX/Microsoft, Inc., MACINTOSH/Apple Computer, Inc., VAX/DEC CIRCLE NO. 119 ON READER SERVICE CARD

application generation

c-tree/r-tree - with

**LETTERS** 

It also strikes me that whereas portability is ranked first among the assets of C, this is a nonissue for microcomputers. The hardware producer whose machine, operating system, and compilers will not accept all computer languages in common use is certainly courting trouble.

Judging by my experience with BASIC, an easy language by all accounts, I go along with the conclusion that C requires considerable study and discipline. I would add it is not recommended for applications work.

On more familiar ground, I have Microsoft's QuickBASIC 4 (QB4), which received a good review in your May issue (Product Watch, Justin Crom, p. 149), and deservedly so. The development speed is a big step forward. I still am doing better work in BASICA thanks to Betatool's BASIC Development System, a product that deserves rave reviews. I use QB3 or QB4 for final touching up and compiling only.

One last point. We who use BASIC, the interpreter in particular, are a little tired of criticism of its lack of structure and its "spaghetti" code. The facility is there to write good, structured, documented, and maintainable code, but it is not forced-it is in the hands of the programmer. This is an asset, for in putting together very complex algorithms, the departure from a structured approach is essential. I use BASIC for work ranging from engineering to accounting and communications and have yet to be beaten by a problem I could not solve.

I would also like to congratulate Will Fastie on his column, "The Trouble with C" (New Directions, February 1988, p. 27). It was a brave editorial.

> Cyril L. Kidson 11 Edenrust Terrace Road Edenvale, South Africa

### **COMMENTS WELCOME**

All letters to the editor should be directed to Editor, PC Tech Journal, Suite 800, 10480 Little Patuxent Parkway, Columbia, MD 21044. Correspondence also can be submitted over MCI Mail to PCTECH.

Although PC Tech Journal cannot publish all letters received. every effort is made to answer as many as possible. Please keep letters to the point, and include name. mailing address, and telephone number; when a letter is lengthy, a diskette is appreciated.

# DECLARATION of INDEPENDENCE

in'de-pen'dent (in'di-pen'dent) adj. 1. not influenced by others in opinion, conduct, etc. 2. not affiliated; sovereign in authority. –n. (in'de-pen-dence) someone or something independent.

# FACT:

Many major dealers specializing in programming tools for personal computers are legal affiliates of companies who also publish development software.

### FACT

Programmer's Connection is *not* a publisher and is *not* affiliated to any company that has ever been in the business of publishing software.

When you come to Programmer's Connection, you'll find our knowledgeable, non-commisioned salespeople and technical consultants will give you an unbiased look at the products we carry.

Please join us in our Declaration of Independence. Call Programmer's Connection today and be sure to ask for your FREE subscription to the Connection, our 120 page comprehensive buyer's guide. It contains descriptions for over 750 products by more than 250 manufacturers, and informative articles by leaders in the programming industry.

# **CALL for Products Not Listed Here**

# USA...... 800-336-1166

| Canada                  | 800-225-1166 |
|-------------------------|--------------|
| Ohio & Alaska (Collect) | 216-494-3781 |
| International           |              |
| FAX                     | 216-494-5260 |
| TELEX                   | 9102406879   |

Business Hours: 8:30 AM to 8:00 PM EST Monday through Friday Prices, Availability, Terms and Conditions are subject to change. 
©Copyright 1988 Programmer's Connection Incorporated

# PROGRAMMER'S CONNECTION

| 386 products                                      | List       | Ours |  |
|---|------------|------|--|
| 386 ASM/386 LINK Cross Asm by Phar Lap            | 495        | 389  |  |
| 386 DEBUG Cross Debugger by Phar Lap              | 195        | 145  |  |
| NDP C-386 by MicroWay                             | 595        | 529  |  |
| NDP ForTran-386 by MicroWay                       | 595        | 529  |  |
| PC-MOS/386 by The Software Link All Varieties     | CALL       | CALL |  |
| VM/386 by IGC                                     | 245        | 219  |  |
|   | 240        | 213  |  |
| blaise products                                   |            |      |  |
| ASYNCH MANAGER Specify C or Pascal                | 175        | 135  |  |
| C TOOLS PLUS/5.0                                  | 129        | 99   |  |
| POWER SCREEN Supports C and Pascal                | 129        | 99   |  |
| Turbo ASYNCH PLUS/4.0                             | 129        | 99   |  |
| Turbo C TOOLS                                     | 129        | 99   |  |
| Turbo POWER TOOLS PLUS/4.0                        | 129        | 99   |  |
| borland products                                  |            |      |  |
| Paradox 2.0 by Ansa/Borland                       | 725        | 525  |  |
| Paradox 386 by Ansa/Borland                       | 895        | 639  |  |
| Paradox Network Pack by Ansa/Borland              | 995        | 725  |  |
| Paradox OS/2 by Ansa/BorlandNew                   | 725        | 545  |  |
| Quattro: The Professional Spreadsheet             | 247        | 179  |  |
| Sidekick Plus.                                    | 200        | 125  |  |
| Sprint: The Professional Word ProcessorNew        | 200        | 135  |  |
| Turbo Basic Compiler                              | 100        | 68   |  |
| Turbo Basic Support Products All Varieties        | 100        | 68   |  |
| Turbo C Compiler.                                 | 100        | 68   |  |
| Turbo Pascal Compiler                             | 100        | 68   |  |
| Turbo Pascal Developer's Toolkit                  | 395        | 285  |  |
| Turbo Pascal Support Products All Varieties       | 100        | 68   |  |
| Turbo Pascal Tutor.                               | 70         | 49   |  |
| Turbo Prolog Compiler                             | 150        | 115  |  |
| Turbo Prolog Toolbox                              | 100        | 68   |  |
| Other Borland Products                            | CALL       | CALL |  |
| c language  |            |      |  |
| CBTREE by Peacock Systems                         | 159        | 129  |  |
| CQL by Machine Independent Software               | 395        | 329  |  |
| Eco-C88 Modeling Compiler by Ecosoft              | 100        | 69   |  |
| GraphiC by Scientific Endeavors                   | 395        | 309  |  |
| Lattice C Compiler from Lattice                   | 450        | 289  |  |
| Mark Williams Let's C with FREE csd               | 75         | 54   |  |
| Vitamin C by Creative Programming                 | 225        | 159  |  |
| VC Screen Forms Designer                          | 150        | 119  |  |
| Reference Database for Norton Guides              | 50         | 47   |  |
| WATCOM C6.5 by WATCOM GroupNew Version            | 295        | 269  |  |
| database management                               |            |      |  |
|   | COF        | 519  |  |
| Clipper by NantucketdBASE III Plus by Ashton-Tate | 695<br>695 | 439  |  |
| dBXL by WordTech Systems                          | 199        | 169  |  |
| FoxBASE+ by Fox Software                          | 395        | 249  |  |
| FoxBASE+/386 by Fox Software                      | 500        | 359  |  |
| FrontRunner by Ashton-Tate                        | 195        | 175  |  |
| Genifer by bytel                                  | 395        | 249  |  |
| MAGIC PC by AKER                                  | 199        | 179  |  |
| Networker Plus by WordTech SystemsNew             | 259        | 209  |  |
| QUICKSILVER by WordTech Systems New               | 599        | 349  |  |
| ZIM by Zanthe Information                         | 880        | 769  |  |
|   |            |      |  |

| faircom products                            |            |            |
|---|------------|------------|
| c-tree & r-tree Combo                       | 650        | 519        |
| c-tree ISAM File Manager                    | 395        | 315        |
| r-tree Report Generator                     | 295        | 239        |
| d-tree                                      | 495        | 419        |
| metaware products                           |            |            |
| High C                                      | 595        | 529        |
| 386 Version                                 | 895        | 799        |
| Professional Pascal                         | 595        | 529        |
| 386 Version                                 | 895        | 799        |
| microsoft products                          |            |            |
| Microsoft BASIC Compiler                    | 295        | 219        |
| Microsoft C Compiler w/CodeView             | 450        | 299        |
| Microsoft COBOL Compiler w/ToolsNew Version | 900        | 659        |
| Microsoft FORTRAN Optimizing Comp           | 450        | 299        |
| Microsoft Macro Assembler                   | 150<br>350 | 105<br>239 |
| Microsoft QuickBASIC                        | 99         | 69         |
| Microsoft QuickC                            | 99         | 69         |
| Microsoft Windows                           | 99         | 69         |
| Microsoft Windows 386                       | 195        | 129        |
| Microsoft Windows Development Kit           | 500        | 329        |
| Other Microsoft Products                    | CALL       | CALL       |
| mks products                                |            |            |
| MKS AWK                                     | 75         | 69         |
| MKS RCS Rev Control System                  | 189        | 169        |
| MKS SQPS SoftQuad Publishing Software       | 495        | 449        |
| MKS Toolkit with MKS VI                     | 169        | 129        |
| MKS Trilogy with AWK, CRYPT & Kom Shell     | 119        | 105        |
| MKS VI Editor                               | 75         | 69         |
| novell products                             |            |            |
| Btrieve ISAM Mgr with No Royalties          | 245        | 184        |
| Xtrieve Query Utility                       | 245        | 184        |
| Report Option for Xtrieve                   | 145        | 99         |
| Btrieve/N for Ne*works                      | 595        | 454        |
| Xtrieve/N                                   | 595        | 454<br>269 |
| XQLXQL                                      | 345<br>795 | 599        |
|   | 130        | 033        |
| peter norton products                       | THE P      | 40         |
| Advanced Norton Utilities                   | 150        | 89<br>55   |
| Norton Commander                            | 75<br>75   | 59         |
| Norton Guides                               |            | 65         |
| for OS/2                                    | 150        | 109        |
| Norton Utilities                            | 100        | 59         |
| polytron utilities                          |            |            |
| PolyAWK Programming LanguageNew             | 99         | 95         |
| PolyMake UNIX-like Make                     | 149        | 135        |
| PolyShell UNIX shell for DOS                | 99         | 95         |
| PVCS Corporate Version Control              | 395        | 359        |
| PVCS Personal                               | 149        | 135        |
| sco products                                |            |            |
| XENIX System V for ESDI                     | CALL       | CALL       |
|   |            |            |

CIRCLE NO. 175 ON READER SERVICE CARD

# ORDERING INFORMATION

FREE SHIPPING. Orders within the USA (lower 48 states only) are shipped FREE via UPS Ground. Call for APO, FPO, PAL, and express shipping rates.
NO CREDIT CARD CHARGE. VISA, MasterCard

NO CREDIT CARD CHARGE. VISA, MasterCard and Discover Card are accepted at no extra cost. Your card is charged when your order is shipped. Mail orders please include expiration date and authorized signature.

NO COD OR PO FEE. CODs and Purchase Orders are accepted at no extra cost. No personal checks are accepted on COD orders. POs with net 30-day terms (with initial minimum order of \$100) are available to qualified US accounts only.

NO SALES TAX. Orders outside of Ohio are not charged sales tax. Ohio customers please add 5% Ohio tax or provide proof of tax-exemption.

30-DAY GUARANTEE. Most of our products come with a 30-day documentation evaluation period or a 30-day return guarantee. Please note that some manufacturers restrict us from offering guarantees on their products. Call for more information.

SOUND ADVICE. Our knowledgeable technical staff can answer technical questions, assist in comparing products and send you detailed product information tailored to your needs.

INTERNATIONAL ORDÉRS. Shipping charges for International and Canadian orders are based on product weight. The standard rates used are published in the Fall 1988 issue of our Buyer's Guide. If you do not have a copy, please call or write for the exact cost. All payments must be made with US funds drawn on a US bank. Please include your telephone number when ordering by mail. Due to government regulations, we cannot ship to all countries.

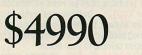
MAIL ORDERS. Please include your telephone number and complete street address on all mail orders. Be sure to specify computer, operating system, diskette size, and any applicable compiler or hardware interface(s). Send mail orders to:

Programmer's Connection Order Processing Department 7249 Whipple Ave NW North Canton, OH 44720

| XENIX System V for PS/2                        | CALL | CALL |
|--|------|------|
| XENIX System V 286                             | 1295 | 979  |
| XENIX System V 386                             | 1595 | 1179 |
| text editors                                   |      |      |
| Brief by Solution Systems                      | 195  | CALL |
| Epsilon Emacs-like editor by Lugaru            | 195  | 169  |
| KEDIT by Mansfield Software                    | 150  | 129  |
| other products                                 |      |      |
| Carbon Copy Plus by Meridian Technology        | 195  | 135  |
| CCExpress by Meridian Technology               | 345  | 289  |
| Dan Bricklin's Demo II by Software Garden      | 195  | 179  |
| Desqview from Quarterdeck                      | 130  | 115  |
| Interactive EASYFLOW by Haventree              | 150  | 125  |
| Link & Locate by Systems Software              | 350  | 319  |
| Link & Locate + + by Systems Software          | 395  | 369  |
| OPT-Tech Sort by Opt-Tech Data Proc            | 149  | 129  |
| Periscope All VarietiesNew Version             | CALL | CALL |
| Personal REXX by Mansfield Software            | 125  | 99   |
| SLATE by Symmetry Group                        | 299  | 269  |
| with Source Code                               | 698  | 629  |
| Sortex by Systemat                             | 150  | 129  |
| SOURCER w/BIOS SOURCE by V Communications .New | 140  | 125  |
| TLIB Version Control by Burton Systems         | 100  | 89   |
| 5 Station LANNew                               | 300  | 269  |
|  |      |      |







DN3000 with 15" 1024 x 800 monochrome display



DN3000 with 19" 1280 x 1024 monochrome display



# If you think we don't have UNIX workstation for und



DN3500 MC68030-based 4-MIPS workstation with 15" 1024 x 800 monochrome display



DN3500 MC68030-based 4-MIPS workstation with 19" 1280 x 1024 monochrome display



DN3500 MC68030-based 4-MIPS workstation with 15" 1024 x 800 color display

Open Software

FOUNDATION Apollo is proud to be a founding sponsor of the Open Software Foundation.

At Apollo, we believe that the real test of a computer company is not only how often it introduces new technology, but also how quickly it makes that technology available at a truly affordable price.

As testimony to this, we offer not simply one workstation under \$10,000, but two entire families of workstations, one of which starts at under \$5,000.

Consider the Series 3000.™ A Personal Workstation™ powered like a Porsche® but priced like a PC. \$4,990, to be exact. And the new Series 3500.™ An MC68030 machine that brings high performance to a new low. Making it possible for the first time to obtain a

# a single high-performance er \$10,000, you're right.

4-MIPS monochrome system for less than \$8,000, and a 4-MIPS color system for less than \$10,000.

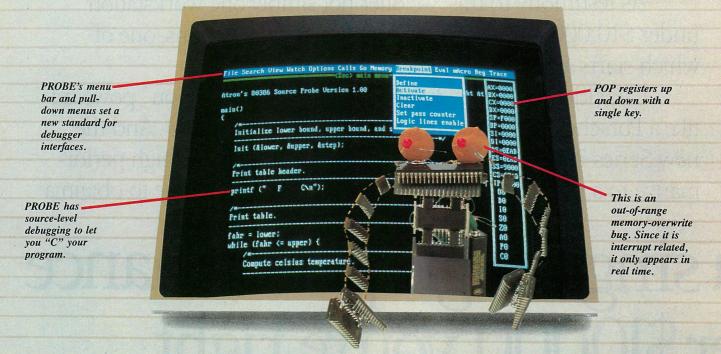
Prices that even include 4MB of memory, a floating-point coprocessor, an IBM PC AT\* compatible bus, and a choice of Ethernet\* or Apollo Token Ring networks.

In addition, like all Apollo workstations, these provide support for industry standards such as UNIX® (System V.3 and Berkeley 4.3), PHIGS, X Window System™ and a host of others, as well as network computing and PC compatibility.

The Apollo Series 3000 and Series 3500. Technology as high as the price is low.

# apollo

# IT'S TIME TO DO SOME SERIOUS 386 BUGBUSTING!



relcome to your nightmare. Your company has bet the farm on your product. Your demonstration wowed the operating committee, and beta shipments were out on time. Then wham!

All your beta customers seemed to call on the same day. "Your software is doing some really bizarre things," they say. Your credibility is at stake. Your profits are at stake. Your sanity is at stake.

### THIS BUG'S FOR YOU

You rack your brain, trying to figure something out. Is it a random memory overwrite? Or worse, an overwrite to a stack-based local variable? Is it sequence dependent? Or worse, randomly caused by interrupts? Overwritten code? Undocumented "features" in the software you're linking to? And to top it off, your program is too big. The software debugger, your program and it's symbol table can't fit into memory at the same time. Opening a bicycle shop suddenly isn't such a bad idea.

### THIS DEBUGGER'S FOR YOU

Announcing the 386 PROBE™ Bugbuster,\*from Atron. Nine of the top-ten software developers sleep better at night because of Atron hardware-assisted debuggers. Because they can set real-time breakpoints which instantly detect memory reads and writes.

Now, with the 386 PROBE, you have the capability to set a *qualified breakpoint*, so the breakpoint triggers only if the events are coming from the wrong procedures. So you don't have to be halted by breakpoints from legitimate areas. You can even detect obscure, sequence-dependent problems by stopping a breakpoint only after a specific chain of events has occurred in a specific order.

Then, so you can look at the cause of the problem, the 386 PROBE automatically stores the last 2K cycles of program execution. Although other debuggers may *try* to do the same thing, Atron is the only company in the world to dequeue the pipelined trace data so you can easily understand it.

Finally, 386 PROBE's megabyte of hidden, write-protected memory stores your symbol table and debugger. So your bug can't roach the debugger. And so you have room enough to debug a really big program.



### COULD A GOOD NIGHT'S SLEEP PUT YOU IN THE TOP TEN?

Look at it this way. Nine of the top-ten software products in any given category were created by Atron customers. Maybe their edge is - a good night's sleep.

Call and get your free, 56-page bugbusting bible today. And if you're in the middle of a nightmare right now, give us a purchase order number. We'll FEDEX you a sweet dream.



A division of Northwest Instrument Systems, Inc. Saratoga Office Center ● 12950 Saratoga Avenue Saratoga, CA 95070 ● Call 408/253-5933 today.

# **NEW DIRECTIONS**

# Analyzing the Apple Suit

Until Apple's lawsuit against Microsoft and HP are resolved, questions linger about Windows and Presentation Manager.



It is the lawsuit that rocked the industry, the legal battle that couldn't happen. Apple's lawsuit against Microsoft and Hewlett-Packard, claiming violation of a license agreement and copyright infringement in the Windows and NewWave products, is so complicated and so fraught with potential for unsatisfactory resolution—not only for both companies but also their customers—that many observers wonder what prompted Apple to proceed in the first place.

We may never know Apple's motivation, especially if the dispute is settled out of court. Nonetheless, some of the possible outcomes of the lawsuit represent serious problems for systems developers and integrators who currently are building applications for Windows or plan to do so for the OS/2 Presentation Manager (which certainly can be thought of as a derivative work of Windows).

To recognize the dangers, we must understand the complexity of the legal issues surrounding it. For that, we have turned to attorney Max Stul Oppenheimer, our long-time contributing editor on computer-related legal matters. Even given the complexity of the matter, you might be interested to know that Oppenheimer thinks Apple has a case, certainly not clear cut, but a position that is defensible. His analysis begins in the sidebar on page 24.

### **DEVELOPMENT DANGERS**

If you are working with Windows, and especially if you are a vendor of Windows-based products, an Apple victory in this legal action likely will affect you. The question is how, and many answers are possible (depending upon the precise outcome, whether it be an out-of-court settlement or a trial verdict). Some of the courtroom activity might be based solely on factual matters, but as Oppenheimer indicates, nightmarish scenarios arise from the

complexity of the copyright issues and the ultimate judgment and rulings from the court. Let's examine some of the possible outcomes.

A decision to settle out of court would imply that Apple's goal in filing the suit was royalties and that the parties were able to agree on a price. This could also involve retroactive payments for the installed base of Windows and might affect the Windows runtime environment as well.

This outcome poses little threat to the developer. Such a solution is unlikely to satisfy Microsoft unless the price is right and the settlement involves no development work. Thus, it would probably not mandate changes to either the Windows or Presentation Manager code, applications program interface (API), or design; the developer could proceed as if nothing at all had happened. In the event that changes were required, they would probably be minor and produce little or no inconvenience.

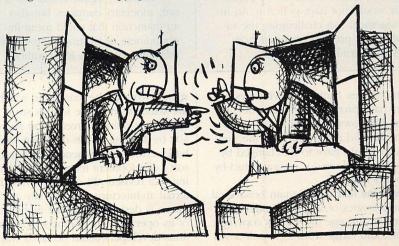
If the case makes it to court, the issue of the license will be considered first. As Oppenheimer points out, Microsoft (in a very quick and clever move) managed to get the court to consider the suit in two phases—license agreement first, copyright in-

fringement second. If the court finds that Microsoft has a valid license with Apple and has not violated its terms, the lawsuit will come to an immediate conclusion. Microsoft then will be free to pursue Windows and Presentation Manager, with no changes required. Developers will not be affected.

If, however, the court finds Microsoft to be in violation of the license terms, then the suit will move on to the copyright issue. Oppenheimer calls this a major "gray area;" the outcome is unpredictable because the judge will be breaking new legal ground on a case that many legal scholars and observers believe ultimately will reach the U.S. Supreme Court.

The effect upon developers, therefore, depends on what the court might order if Windows is found to infringe on the Mac interface copyrights.

Change the visuals. One possibility is that only the visual appearance of Windows infringes. If so, Microsoft will be forced to rework the product so that it somehow looks sufficiently different from the Mac interface. However, all the same elements of Windows could be present (check boxes, menus, radio buttons, scroll bars); because these are system resources, a developer would probably not have to make any applica-



Daga VI DISTONI - MACIEN AI DBECT

# **DOES APPLE HAVE A CHANCE?**

Suppose that about a year ago, you and I had been negotiating a contract for the purchase of a computer system based on IBM-compatible hardware and work-alike software. My standard contract would have contained provisions warranting that the hardware and software did not infringe any third-party rights, and it would have recited remedies in case anyone claimed that our system did infringe their rights.

Broderbund Software and Lotus were already making broad claims of ownership against work-alike or look-alike software, based on the judicial decision in Whelan v. Jaslow Dental Labs, the case that brought the phrase *look and feel* to computer law (see "Regional Copyright Law," Expert Consultant: Computer Law, Max Stul Oppenheimer, August 1987, p. 219). We, therefore, would have fought hard for some degree of infringement protection.

Now suppose instead that we had been negotiating a contract for the purchase of an IBM/Microsoft system from an authorized IBM dealer. We undoubtedly would have abandoned our request for protection against third-party infringement claims, trusting that IBM, regardless of contractual obligation, would vigorously defend any claim of infringement; we would have assumed that any product marketed under IBM's logo had been developed by or licensed to IBM

Even had we the incredible foresight to suggest that, because Microsoft Windows (and thus IBM's Presentation Manager) looks like Apple's Macintosh interface, we needed indemnification, we probably would not have gotten it. An infringement suit challenging the validity of a product obtained from IBM just could not happen.

Should the outcome of the negotiations be different today? What impact does Apple's now-infamous lawsuit have? Apple claims that Microsoft Windows (and by inference IBM's Presentation Manager) and Hewlett-Packard's NewWave copy from the Mac interface. Should developers and end users be worried about the outcome of this case?

In one sense, the Apple lawsuit is unremarkable. It breaks no new legal theoretical ground: Congress has made it clear that computer software can be copyrighted; there is no serious room for doubt that computer screen displays, although theoretically transitory, also can be copyrighted. Furthermore, the Whelan case presaged at least the allegation of infringement of the look and feel of software.

In another sense, however, the Apple lawsuit is the kind of lawsuit that can't happen. It is against major, established companies with huge user bases, and it claims ownership of a fundamental expression. It challenges the right to conform to an industry-standard user interface.

Let us begin by assuming that Apple has no ulterior motives in bringing this lawsuit, that it simply wants royalties for the use of its copyrighted work and a prohibition of further misappropriation of its property. Suppose further that the case is tried to a conclusion and that Apple prevails. Obviously, that hurts Microsoft and Hewlett-Packard, but does it affect people whose only connection with the matter is their purchase of Windows or Windowsbased applications?

In theory, Apple could win not only monetary damages, but also an injunction that could mean impoundment of existing copies of the infringing products. Even without taking this drastic step, Apple could put a serious kink in the operations of end users. For example, if Apple impounded all of Microsoft's copies of the product (and all manuals and papers pertaining to it), support would become a nightmare. This would slow enhancements to a near standstill. If a near standstill seemed too speedy to Apple, it could enjoin further copying or preparation of derivative works and thus reduce the value and eliminate further growth of the existing software.

Does that mean buying Windows is unwise? Several factors suggest not. The above scenario assumes that the case would be tried to a conclusion and that Apple would win; however, it could be settled out of court. Moreover, even if it goes to trial, Apple must deal with difficult factual and legal issues before it could win.

The first factual issue is whether Apple has licensed Microsoft to produce and market Windows. (Hewlett-Packard has not claimed that it has a license.) Both sides have released a copy of an agreement settling an earlier dispute, and both claim that it supports their position. The license issue is, essentially, this: did Apple license Microsoft to continue the development of Windows, or did it only license a fixed-in-time version? The agreement is ambiguous enough to require outside testimony in order to reach a conclusion.

The judge has decided to resolve the licensing issue before turning (if necessary) to the question of whether Apple has a copyright that is being infringed. If Microsoft prevails at the first stage—if it has a valid license—it does not matter whether or not Windows infringes Apple's copyright.

tion changes. Numerous Windows vendors have provided capability beyond what Windows offers directly, so any item that did not conform to the new design would have to be changed by the individual vendor on a product-by-product basis.

Change the function. Certain behavioral characteristics of Windows might be found to infringe on Apple's copyright. This could range from how pull-down

menus work to the manner in which the Windows message loop is structured. Any change forced upon Microsoft by a ruling in this direction would have serious consequences for Microsoft's development team, perhaps leading to a revised API or even a new internal architecture. Because any application is designed to fit the architecture of its operating environment, applications developers could be faced with

revisions of great magnitude requiring significant amounts of software engineering time. The actual volume of work required would depend upon the severity of the internal changes.

Such sweeping internal changes would have two effects. The first, of course, would be a major disruption in the Windows and Presentation Manager markets as vendors took a big time-out to revise existing products. That would Even if the judge concludes that the license agreement is not broad enough to permit what Microsoft has done, Microsoft could still prevail if it persuades the court that Apple does not have a valid copyright. The copyright could be deemed invalid on two points: if Apple is not the author of the system, or if the system cannot be copyrighted (either because it is in the public domain or because the system does not contain copyrightable subject matter).

Many ideas for the Macintosh visual interface originated in a system developed by Xerox, called SmallTalk. Because a sequentially developed program can have more than one copyright, Xerox could hold one to its original product, while Apple holds a copyright to any significant, subsequent contributions (although for Apple to use the program without authority from Xerox would still constitute infringement). Someone making a copy or adaptation of the enhanced work could infringe both copyrights. Xerox's decision not to claim infringement would not deprive Apple of its right to do so. However, Apple must walk a tightrope because the same issues that exist between Apple and Microsoft also are present between Apple and Xerox.

Another issue is whether or not Apple's additions constitute an independent, copyrightable work. A translation of a work from one language to another is an adaptation of the original work and would infringe on its copyright. The result is trickier, however, where the translation involves copying screen displays but, because of the different capabilities of different machines, accomplishes different functions (or similar functions differently) behind

the screens. Separate copyrights may exist for both the screen displays and the underlying code.

A third possible issue is whether a work that initially is copyrightable might fall into the public domain because it has become an industry standard. The copyright act, by its terms, protects expression, not ideas. In a previous lawsuit filed by Apple against Franklin Computer, the court concluded that Apple's programs were copyrightable expressions because the underlying ideas could be expressed in more than one way. But can a copyright be limited if a particular expression has become the only way to express the concept—in other words, an industry standard?

The courts have supported the view that a graphics interface, upon introduction, can be copyrighted; but once it becomes so accepted that no other method of user interface can accomplish the same result, the copyright requirements might no longer be met. Legal scholars may object that such an approach violates the Fifth Amendment (which prevents the government from taking an individual's property rights without compensation), but taking away the right to a copyright is different from limiting its scope in the first place.

All this analysis leaves us, I am afraid, with the conclusion that the Apple case poses some difficult issues, and it is impossible to predict the outcome. A full trial and appeals could take years. What do you do in the meantime?

First, take care to read contracts carefully, even when dealing with big-name companies. In particular, pay attention to infringement clauses. Where they are absent, do

Continued on p. 27

delay updates to existing products and the appearance of new products on the market. It would also set back internal development schedules for businesses using these environments for proprietary applications.

The second effect is that some smaller vendors of Windows or Presentation Manager products might go out of business for lack of resources to make the changes *and* maintain their

development schedule. In addition, the cost of updating the customer base with the non-infringing software must be considered, should the court make the requirement retroactive.

Invalidate the product. This is the ultimate nightmare. Although hard to imagine, the court could rule that Microsoft could no longer market the products—and even that all installed copies should be impounded.

# SLATE

# A Universal Printer Driver with more than 250 printers Preconfigured.

### **FEATURING**

- Extensive C Libraries to simplify programming
- Field Definition of New Printers by customers or nonprogrammers
- No Royalties
- Simple Reports to Desktop Publishing
- Less Expensive than developing one new Printer Driver

#### PLUS

Font Selection including "Best Match"
Typeface, Size, Bold, Italic, and
Proportional Font Selection
Continuous or Interrupted Underline
Automatic Font Downloading
Automatic Pagination, Headings, and

Footings
Fine Position control without Floating
Point

Field configurable Paper Setup Corrections

Field configurable Printer Routing with port selection and switch codes Adjustable Vertical Line Spacing

Adjustable Vertical Ellie Spacing
Adjustable Horizontal Character
Spacing

Full 8 bit Character Sets and Character Remapping

Extensive Library including *printf*Display independent Message System for errors

Current Data Access including Position and String Printing Width
Line & Block Drawing for Laser Printers

Line & Block Drawing for Laser Printers
Paper Source Control

SLATE is available immediately for \$299 with our risk free, 30 day return policy. Also available in combination with our S\_PRINT Text Processing System for \$349, a \$99 savings.

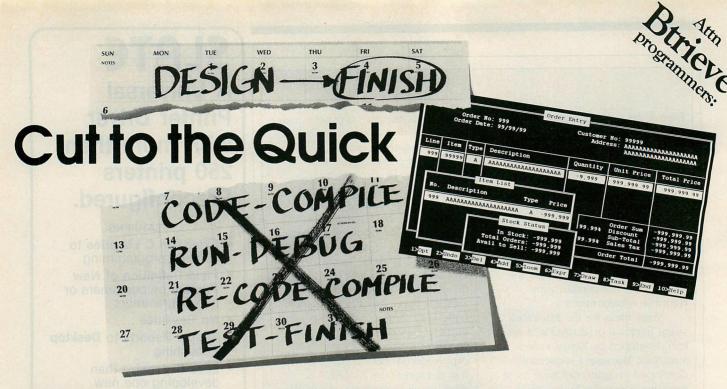
TO ORDER CALL

800-346-3938

The Symmetry Group

P.O. BOX 26195 COLUMBUS, OH 43226-0195 614-431-2667

CIRCLE NO. 152 ON READER SERVICE CARD



MAGIC PC ELIMINATES CODING ... CUTS MONTHS OF DATABASE DEVELOPMENT!

Time is money. And coding a DBMS application like Accounting or Order Entry takes a lot of both. Simply because hacking out mountains of code with your RDBMS or 4GL is too slow. Not to mention the time to rewrite if you make a mistake or change the design.

# EXECUTION TABLES ELIMINATE CODE!

Magic PC cuts months of your application development time because it eliminates coding. You program with the state-of-the-art Execution Tables in place of conventional programming.

### **HOW DOES IT WORK?**

Magic PC turns your database design scheme directly into executable applications without any coding. Use Execution Tables to describe only what your programs do with compact design spec's, free from lengthy how to programming details. Each table entry is a powerful non-procedural design instruction which is executed at compiled-like speed by a runtime engine. Yet the tables can be modified "on the fly" without any maintenance. Develop full-featured multi-user turnkey systems with custom screens, windows, menus, reports and much more in days - not months! No more low-level programming, no time

Requires IBM/100% comp., 512K, hard disk. DOS 3.0 or later. Includes BTRIEVE runtime. Not copy protected. 2 5.25-inch disks. All trademarks acknowledged. © Copyright 1988 Aker Corp.

# MAGIC PC

The Will Database Language



"Magic PC's database engine delivers powerful applications in a fraction of the time... there is no competitive product."



"Overall, Magic PC is one of the most powerful DBMS packages available."

- Quick Application Generator
- BTRIEVE® based multi-user RDBMS
- Visual design language eliminates coding
- Maintenance-free program modifications
- Easy-to-use Visual Query-By-Example
- Multi-file Zoom window look-ups
- Low-cost distribution Runtimes
- OEM versions available

### **ATTENTION BTRIEVE® USERS**

Now you can quickly enhance your BTRIEVE®-based applications beyond the capabilities of XTRIEVE® and RTRIEVE®. Use Magic PC as a turn-key BTRIEVE® Application Generator to customize your applications without even changing your existing code.

# AKER

19782 MacArthur Boulevard, Suite 305 Irvine, California 92715

TLX: 493-1184

FAX: 714-955-0199

# **DATABASE PROGRAMMERS**

Join the thousands of professional database programmers and vertical market developers who switched to Magic PC from dBase®, R:BASE®, Paradox®, Clipper®, Dataflex®, Revelation®, Basic, C, Pascal, etc.

# TRY BEFORE YOU PAY

We're so sure you'll love Magic PC—we'll let you try the complete package first. Only a limited quantity is available, so call us today to reserve your copy. Pay for Magic PC only after 30 days of working with it.\* To cancel... don't call... simply return in 30 days for a \$19.95 restocking fee.

### OR PAY NOW AT NO RISK

Pay when you order and we'll wave the \$19.95 restocking fee so you have absolutely no risk,

SPECIAL OFFER 595

**\$199** 



Magic LAN multi-user — \$399 Magic RUN — call for price

# Order Now Call: 800-345-MAGIC

In CA 714-250-1718

BS CL CS DB DD MS PT TT DS XX
Add \$10 P&H, tax in CA. International orders add \$30.
\*Secured with credit card or open P.O. Valid in US.
Dealers welcomed

not be embarrassed to ask for them. Where specific disclaimers or limitations of rights exist in the case of infringement claims, evaluate what you are being asked to give up.

For those who did not negotiate custom contracts with Microsoft. there is still hope: several principles favor the protection of the end user. The Uniform Commercial Code (UCC), which is law in most states. provides that, unless otherwise agreed, a dealer must deliver products free of infringement claims. The courts have interpreted software as being covered by the UCC (see "Software Goods or Services," Legal Brief, Max Stul Oppenheimer, May 1986, p. 207).

Therefore, carefully read the single page of Microsoft fine print headed "IMPORTANT—READ CAREFULLY BEFORE OPENING," which many people probably are now reading for the first time. You will find that some of its provisions are inconsistent: it has a general disclaimer of warranties, but a specific warranty of ownership (the statement, "we own this software," is a warranty). Since Micro-

soft wrote the contract (if it is a contract), the ambiguity normally will be construed in favor of the user's rights. A recent Fifth Circuit Court of Appeals decision (Vault v. Quaid) affirmed the unenforceability of shrink-wrapped license agreements. Thus, in states where the UCC is law (including Microsoft's home state, Washington), the UCC's implied warranties would apply.

Therefore, despite any failure to negotiate meaningful remedies, you still have protection, at least against the risk of having to pay copyright damages for having used a legitimately purchased copy of Windows.

Regardless of the outcome, perhaps we should take a lesson from what might be, readjust our views of what cannot happen, and consider how to protect ourselves against the impossible. —Max Stul Oppenbeimer

Max Stul Oppenheimer is the chairman of the Technology Law Group of Venable, Baetjer and Howard in Baltimore, Maryland. He is on the faculty of Johns Hopkins University and author of Chips! Strategic Issues in Computer Industry Negotiations (Dow Jones Irwin, 1987).

I called a number of Windows vendors to ask what would happen to them in such a case. Their obvious answer: "We'd be out of business." Some indicated that they had sufficient cash to direct their attention to other market areas, especially if they stripped down to a minimal work force. Some indicated that their other offerings, such as Mac or non-Windows products, could tide them over. Most, however, felt that the end would come swiftly.

### THE RISK FACTOR

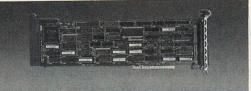
None of the vendors with whom I spoke believes that anything like the worst case will actually come about. Most think that Apple and Microsoft will settle and that the settlement will involve royalties to Apple. Should the case go to court, most agree that, at most, Microsoft will have to make changes to the visual appearance of Windows and, as a consequence, to Presentation Manager.

Steve Ballmer, Microsoft's vice president of systems marketing, made the same point in a speech at PC Tech Journal's Systems Forum '88 in June. In answer to a question from the audience, Ballmer first emphasized that Microsoft believes the suit to be with-

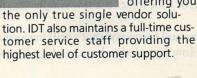
.. The first 9-track magnetic tape controller for IBM's Personal System/2 Micro Channel computers. Our LEO PC tape controller made us famous... Now, for your PS/2, we bring you "FAME" Fast Access Media Exchange.

From the people who brought you the first 9-track tape subsystem for the IBM-PC comes the first 9-track magnetic tape controller and subsystem for the Personal System/2. With the new PS/2's high performance capabilities, you need a high perform-

ance magnetic tape controller, whether your application is moving data between computer systems (including PC's to PS/2's), backing up disk and/or file servers or processing tapes from telephone switching systems, FAME can provide the fast



access you've been looking for. IDT manufactures complete subsystems for both PC and PS/2 computers that include a tape drive, controller, cables, along with extensive software and documentation offering you





For more information call: 1-619-587-0555

**INNOVATIVE** TECHNOLOGY

> 5340 Eastgate Mall · San Diego, CA 92121 (619) 587-0555 • TWX: (910) 335-1610 • FAX: (619) 587-0160

IBM-PC, XT, AT, PS/2 (Personal System/2) and Micro Channel are registered trademarks of International Business Machines Corporation.



TD-1012/FAME Tape Subsystem

IBM's Personal

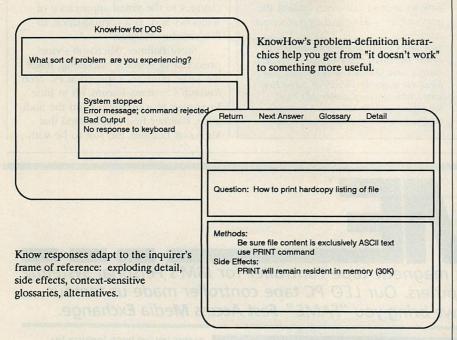
System/2

For all those answers you can't remember -For all those times your expert isn't available -For all those 'howevers' in the back of the book -

# Now there's KnowHow.

KnowHowis the expert application specifically designed to answer "how-to" and "what-went-wrong" questions about your software. KnowHow's interchangeable knowledge bases contain all sorts of cause/effect information: user specs, common errors, sneaky tricks, program bugs. Cross-indexed in ways no flat printed document can match, for diagnosis even without symptoms.

- . Minimize post-installation support by bundling KnowHow/inquiry with your applications.
- . Support your tech support staff and answer more questions on the first call.
- . Get your guru off the phone and back to guru-ing.
- . Use KnowHow anywhere expertise is needed and exerience is in short supply.



# You've got the expert. We've got the system.

LearnHow, KnowHow's knowledge-collection component, lets you supply your own knowledge to KnowHow. LearnHow's heuristic "this happens when" approach reduces and/or/not logic to a few simple yes/no questions.

Back up all that "intellectual property" that's walking around in people's heads. Deposit it in a KnowHow knowledge base, and let KnowHow leverage your expertise.

Single-user, \$365. Multi-user, \$800. Demo, \$20. Call for run-time license.



This Is How 4444 FM 1960 W. Ste 28-261 Houston, TX 77068 (713) 288-4020

CIRCLE NO. 138 ON READER SERVICE CARD

### **NEW DIRECTIONS**

out merit. He then said that if the ruling were to go against Microsoft, it would concern specific items of the Windows visual interface that infringed Apple's copyright; in Ballmer's opinion, if the court so rules, Microsoft will make changes to those specific items—for example, windows might be required to have round corners instead of square ones.

This argument has merit. A similar situation arose between Apple and Digital Research back in 1985 over the appearance of the GEM interface. (GEM has most of the components of the Mac or Windows interface and operates in much the same way. Ventura Publisher is probably the most well-known non-DRI product that uses the GEM interface.) The matter was resolved in a confidential agreement when DRI made changes to the interface that satisfied Apple. DRI CEO Dick Williams will not comment specifically about the agreement, but he says that he and his counsel are confident in their position and in DRI's ability to move forward with GEM, unobstructed by Apple.

All the vendors with whom I spoke say they are aggressively pursuing their pre-litigation business plans without alteration, a sentiment also voiced by both IBM and Microsoft. As if to drive home the point in the midst of the dispute, Microsoft announced a new version of Windows called Windows/286 and a corresponding update to Windows/386 in late June; at the same time, a number of vendors announced updates or new releases of Windows applications. The mood of Microsoft and its independent software vendors (ISVs) is entirely upbeat.

### JUST PLAIN WRONG-HEADED

Another point of agreement from those vendors with whom I spoke is that Apple is just plain wrong-headed in its handling of this matter, for two reasons. To begin with, every vendor thought the suit was inconsistent with Apple's oft-stated, pro-end-user position. They all view the action as contrary to the best interests of end users of IBM-compatible equipment and thus not in keeping with Apple's philosophy. To paraphrase their comments a bit, apparently Apple is pro-user only when the equipment involved is its own.

More seriously, most view the public-relations headache created by the Apple attack as potentially far more damaging to the company than any monetary award could possibly offset. If a generally held negative opinion

# SERIOUS DEBUGGING AT A REASONABLE PRICE



All the speed and power of a hardware-assisted debugger at a software price

Hardware-level break points

REAL-TIME break points on memory locations, memory ranges, execution, I/O ports, hardware and software interrupts. More powerful break points than ANY software-only debugger on the market. Soft-ICE gives you the power of an in-circuit emulator on vour desk.

Break out of hung programs

With a keystroke - no external switch necessary. Even with interrupts disabled.

Breaks the 640K barrier

Soft-ICE uses ZERO bytes of memory in the first 1MB of address space. This is especially useful for those subtle bugs that change when the starting address of your code changes. With Soft-ICE your code executes at the same address whether the debugger is loaded or not.

Works with your favorite debugger

Soft-ICE can be used as a stand-alone debugger or it can add its powerful break points to the software debugger you already use. You can continue to use your favorite debugger until you require Soft-ICE. Simply pop up the Soft-ICE window to set powerful real-time break points. When a break point is reached, your debugger will be activated.

Solve tough systems problems too

Soft-ICE is ideal for debugging TSRs, interrupt handlers, self booting programs, DOS loadable device drivers, non-DOS operating systems, and debugging within DOS & BIOS. Soft-ICE is also great for firmware development because Soft-ICE's break points work in ROM.

# **How Soft-ICE Works**

Soft-ICE uses the power of the 80386 to surround your program in a virtual machine. This gives you complete control of the DOS environment, while Soft-ICE runs safely in protected mode. Soft-ICE uses 80386 protected mode features, such as paging, I/O privilege level, and break point registers, to provide real-time hardware-level break points.

Soft-ICE is a product any MS-DOS developer serious enough to own a 386 machine should have."

Dr. Dobb's Journal -- May 1988

**NEW! NEW! NEW! NEW!** 

# **RUN CODEVIEW** IN ONLY 8K

CodeView is a great integrated debugger, but it uses over 200K of conventional memory. MagicCV uses advanced features of the 80386 microprocessor to load CodeView and symbols in extended memory. This allows MagicCV to run CodeView using less than 8K of conventional memory on your 80386 PC.

Don't let 640K be your limit!

If you are closing in on the 640K limit and would like the power of CodeView, MagicCV is for

Don't let the debugger hide the bug!

Even if you're not closing in on the 640K limit, running CodeView with MagicCV makes your debugging environment much closer to the end user's program environment. You can use CodeView to locate subtle bugs that only occur when there is plenty of free memory, or those difficult bugs that only occur when your program is running with a couple of TSRs loaded.

How MagicCV works

MagicCV uses the 80386 to create a separate virtual machine for CodeView. MagicCV uses between 4K & 8K of conventional memory as a bridge between the DOS environment and Code View.

MagicCV is easy to use
If you are a CodeView user, you already know how to use MagicCV too. Just type MCV instead of CV; everything else is automatic.

**Save \$86** 

**MagicCV** Soft-ICE

\$199 \$386

Buy Both and Save \$86

**CALL TODAY** (603) 888 - 2386

30 day money-back guarantee Visa and Master Card accepted

**NU-MEGA TECHNOLOGIES** 

PO Box 7607 Nashua, NH 03060-7607

Both require 80386 AT compatible or IBM PS/2 Model 80. MagicCV requires at least 384K of extended memory. CodeView is a trademark of Microsoft Corporation.

MagicCV with Soft-ICE

Using Soft-ICE with CodeView gives you the features necessary for professional level systems debugging. MagicĆV and Soft-ICE can work in concert with CodeView to provide the most powerful debugging platform you will find anywhere. As an extra bonus, by ordering both MagicCV and Soft-ICE together you save \$86.

### **NEW DIRECTIONS**

about the company arises, it could adversely affect Apple's efforts to become a serious corporate presence, no matter how good the Mac product line.

If the goal of the lawsuit is to disrupt the windowing environments in the IBM-compatible world in order to make room for a larger Macintosh market share, then Apple miscalculated, according to several of the ISVs with whom I spoke, because machine purchases in the PC world are not yet contingent upon the availability of a win-

dowing environment. Most contemporary applications do not use such environments, and the installed base of users is not yet committed to it.

This means that only Mac devotees would continue to purchase Macs, a situation that would hardly broaden the market. In fact, some integrators say they will not purchase any Apple equipment unless the user interfaces for both Mac and PC systems are similar enough to prevent an increase in their support and training burden.

Even if Microsoft were to be clobbered with a worst-case scenario, developers might have several alternatives. First, a new, non-infringing version of Windows and Presentation Manager could be built from scratch. This would certainly delay the arrival of the environments on our desktops, but because most of today's applications do not run that way to begin with, it would just be an inconvenience. It would not affect sales of PCs.

More interesting is the possibility that Microsoft could license the GEM visual design from DRI or Catalonia's design for its DOS shell, OVERDOS, because GEM has apparently passed Apple's litmus test and Catalonia is not being sued, at least not yet. DRI might even attempt to capitalize on the situation by improving GEM (by adding multitasking to the DOS version) to match the capabilities of Windows.

Microsoft might be able to start over with Xerox, which provided the impetus for the Apple interface in the first place; these companies could work out a license that allowed the pursuit of a PC-based windowing environment that was understood at the outset not to infringe upon Apple's.

Of course, while these possibilities are better than the total elimination of the Microsoft/IBM products, an ISV will face not only major conversion efforts but also a long, long wait.

All these factors taken together indicate that the risk of a catastrophe in the Windows and Presentation Manager market is on the low side. The environment will most likely prevail, but if by chance it does not, another will be available to replace it.

In other words, one way or another, PCs will wind up with a windowing environment.

# **NEW WINDOWS**

It may have been more fuel for the lawsuit fire, or it may have been more evidence that the momentum behind Windows and Presentation Manager is too strong to be subdued. Whatever the case, Microsoft announced an important upgrade to Windows this summer. Both Windows and Windows/386 were upgraded to version 2.1, and Windows was renamed Windows/286.

Critics often cite inadequate performance as the main reason Microsoft Windows will not prevail on hardware at the low end. Frankly, there is quite a bit of truth in that observation. Windows on a CGA-equipped PC/XT, for

# Now COBOL Programmers Can Do Formatted Screens Quickly and Easily - with SCREENIO.

Realia COBOL • Micro Focus COBOL • IBM COBOL/2

SCREENIO is a high-performance, COBOL-specific screen manager for the Personal Computer and compatibles. It's powerful, offers an impressive array of features, yet is easy to use. SCREENIO was written by experienced COBOL professionals and represents a truly COBOL approach to screen management on the PC.

Design and Revise Screens Painlessly with Our Panel Editor.

Use our interactive Panel Editor Facility to design your screens with a What-You-See-Is-What-You-Get approach. You can easily modify and experiment with screen layouts. Type titles and descriptive information on the screen, draw lines and boxes using the cursor movement keys, and paint the colors you want using the cursor keys or block functions. Use all 256 color combinations on your screens.

Programming with SCREENIO is Easy.

You can display your screen and accept data with as few as two statements; a COPY panelname in your WORKING-STORAGE SECTION, and a CALL SCREENIO statement in the PROCEDURE DIVISION. SCREENIO is linked with your application just as any other COBOL subroutine would be.

Yes, we've always done windows. SCREENIO supports Edit Masks, Automatic Error Detection and Editing, High Speed Video, Hot-Fields, Key Redefinition, Foreign Language Capability, Custom Tabbing Order, Color Control at Runtime, PC Speaker Control, and much, much more. A BMS Mapset Import is available. Most programmers are amazed at how easy it is to build flashy applications using SCREENIO and COBOL.

Our Support is Outstanding.

We provide superb telephone support. Upgrades are distributed to licensed users automatically for the first year. There are no Runtime Fees—the code you develop is yours to distribute freely.

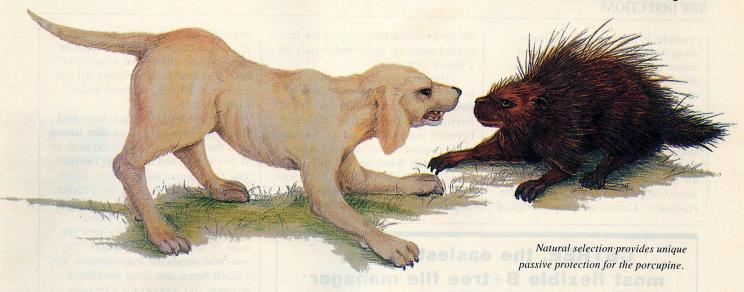
# We'll Send You a Free Demonstration Diskette.

This limited version of our Panel Editor shows how you design panels. Because it's written with COBOL and SCREENIO, it shows the kind of features and performance you can expect in your applications. SCREENIO 2.1 is only \$400 plus shipping. Ask about our other programming tools and package deals, too. In a hurry? Most orders are delivered within 24 hours!

# NORCOM

Northern Computing Consultants P.O. Box 020897 • Juneau, Alaska 99802 (907) 780 6464 • TELEX 510 601 4951 (Norcom)

CIRCLE NO. 191 ON READER SERVICE CARD



# The Block -- Natural Selection For Software Protection



Inventor and entrepreneur Dick Erett explains how "The Activator" provides sane protection for your intellectual property.

f n any industry, just as in nature, the process of natural selection raises one solution above another. Natural selection is the most elegant of engineers.

In the area of software protection The Block has been selected by the market-place as the solution that works. Over 500,000 packages are protected by our device.

For the past 4 years our philosophy has been; 'You have the right and obligation to protect your intellectual property.'

# A New Ethic For Software Protection

In allowing end-users unlimited copies of a software package and uninhibited hard disk and LAN operation, The Block has created a new ethic for software protection.



By removing protection from the magnetic media we remove the constraints that have plagued legitimate users.

They simply attach our key to the parallel port and forget it. It is totally transparent, but the software will not run without it.

# A New Technology For Software Protection

Our newest model, The Activator, builds on our current patented design, and establishes an unprecedented class of software protection.

We have migrated and enhanced the circuitry of The Block to an ASIC (Application-Specific Integrated Circuit) imbedded in The Activator.

This greatly improves speed and performance, while reducing overall size. Data protection can also be provided.

# **Programmable Option**

The Activator allows the software developer the option to program serial numbers, versions, or other pertinent data known only to the developer, into the circuit, and access it from the program.

Once you program your part of the chip, even we have no way to access your information.

The ASIC makes emulation of the device

virtually impossible. It also presents an astronomical number of access combinations.

# Full 100% Disclosure

Since The Activator is protected by our patent we <u>fully disclose</u> how it works. Once you understand it, endless methods of protection become evident.

Just as no two snowflakes are the same, no two implementations of The Activator are identical. And like the snowflake the simplicity of The Activator is its greatest beauty.



We never cramp your programming style or ingenuity. Make it as simple or complicated as you desire.

Let us help safeguard what's rightfully yours. Please call today for additional information or a demo unit. *It's only natural to protect your software.*"

1-800-333-0407 In Connecticut 203-329-8870 Fax 203-329-7428



870 High Ridge Road Stamford, CT 06905

Unlimited Copies • Programmable • Small Size • Fast • Patented • Data Protection

### **NEW DIRECTIONS**

example, is nothing to write home about. Version 2.0 improved performance considerably; Windows/286 is Microsoft's continuing attempt to answer that criticism.

Microsoft is sending an important message by putting the "/286" tag on the new version-8088/86-based machines need not apply. Even though Windows/286 will run on the 8088/86, the packaging clearly states, "For Personal Computers Using an Intel 80286 Processor." Certain new capabilities of the program, such as support for extended memory, are available only on a 286 or better.

The improvement in performance is not easy to detect—only frequent users of the product will notice the differences. The performance difference between versions 1.0 and 2.0 was much more evident. Someone just becoming familiar with Windows will still think the system sluggish; but Microsoft says, for example, that Excel menus pull down 42 percent faster under Windows/286 and that macro execution is 48 percent faster. Aldus, in a separate press release, claims that a variety of tasks performed in PageMaker 3.0 run from 25 to 60 percent faster under Windows/286.

Performance is, in fact, improved. This is my own assessment after having used the system extensively on both an AT Model 339 and a Compaq Deskpro 386. The improvement is more visible on the 386, but the AT is also peppier. Brief experiments on a PS/2 Model 60 also show increased performance.

The real benefits of the new versions of Windows lie elsewhere. The two most significant improvements are a much better and faster installation program and support for a broader range of hardware.

The installation program for both Windows/286 and /386 is better primarily because the SETUP program now determines the equipment configuration for itself. Previously, every component of the system had to be identified by the installer in excruciating detail. The new SETUP program operates along these lines: "This is what I think you have; am I right?"

Also included is a program called MEMSET, which the installation program invokes to examine the memory in the system, suggest an optimal configuration that will best support Windows, and set that up if the installer desires. MEMSET is separate from SETUP, so it can be used to change the configuration of memory without requiring a full Windows installation.

This is a major improvement, but it does not go far enough. The documentation still cautions against installing a new copy of Windows over a previously installed version. SETUP should be able to handle this condition. SETUP still does not properly handle the critical WIN.INI file, which is the much more powerful Windows equivalent of CONFIG.SYS. Although it respects the existence of a previous WIN.INI, SETUP simply renames the old file and replaces it with a new one. A better solution is to merge the contents of the existing WIN.INI into the new one so that the file retains the user's settings, even as SETUP adds new items.

Finally, limited documentation on the subject leaves unclear whether other files in the WINDOWS directory (Excel files, for example) will be left alone, deleted, or somehow modified as a result of the installation. Experience tells me that such files will be untouched, but how can I truly be sure

# CBTREE, the easiest to use, most flexible B+tree file manager for fast and reliable record access

CBTREE... Includes over 8,000 lines of 'C' source code FREE! Since 1984, thousands of 'C' programmers have benefited from using CBTREE.

Save programming time and effort. You can develop your applications quickly and easily since CBTREE's interface is so simple. You'll cut weeks off your development time. Use part or all of our complete sample programs to get your applications going FAST!

Portable 'C' code. The 'C' source code can be compiled with all popular C compilers for the IBM PC including Microsoft C, Quick C, Turbo C, Lattice C, Aztec C and others. Also works under Unix, Xenix, AmigaDos, Ultrix, VAX/CMS, and others. CBTREE includes record locking calls for multi-user and network applications. The CBTREE object module is only 22K and is easy to link into your programs. You don't even pay runtime fees or royalties on your CBTREE applications!

Reduce costs with system design flexibility. CBTREE allows unrestricted and unlimited designs. Reduce your development costs. You define your keys the way you want. Supports any number of keys, variable key lengths, concatenated keys, variable length data records, and data record size. Includes crash recovery utilities and more.

Use the most efficient search techniques. CBTREE is a full function implementation of the industry standard B+tree access method, providing the fastest keyed file access performance

### **Database Calls:**

- · Get first
- · Get last
- Get previous · Get next
- Get less than
- Get less than or equal
- · Get greater than
- · Get greater than or equal
- Get sequential block
- Get partial key match
- · Get all partial matches
- · Get all keys and locations
- Insert key
- · Insert key and record
- · Delete key
- · Delete key and record
- Change record location

# CBTREE is only \$159 plus shipping - a money-saving price!

We provide free telephone support and an unconditional 90-day money back

To order or for additional information on any of our products, call **TOLL FREE** 1-800-346-8038 or (703) 847-1743 or write using the address below.

NEW CBTREE add-on products to make your programming easier. AVAILABLE NOW! • Adhoc query, reporting system; • SQL interpreter.

If you program in 'C', sooner or later you're going to need a B+tree. Don't delay until you're in a crunch, plan ahead, place your order for CBTREE now. Orders shipped within 24 hours!



PEACOCK SYSTEMS, INC. 2108-C GALLOWS ROAD VIENNA, VA 22180

CIRCLE NO. 214 ON READER SERVICE CARD

# No other application development software is quite this fast.



Sure, you expect speed. But not this much speed. Truth is, anyone who has ever developed applications is surprised by PROGRESS. Like the developers who gave it the highest satisfaction rating among the 4GL DBMSs surveyed by DATAPRO\*

PROGRESS is a high-performance 4GL designed specifically for building, modifying, and customizing database applications. It requires less code than other 4GLs, it's crash-proof, and it's transparently portable across UNIX, XENIX, ULTRIX, MS-DOS, VAX/VMS, and CTOS/BTOS, as well as LANS

Well, hold your horses.

### NOW PROGRESS APPLICATION DEVELOPMENT IS EVEN FASTER WHEN YOU ADD PROGRESS FAST TRACK.®

PROGRESS FAST TRACK is a menudriven application builder that allows developers and users to paint screens, create menus, generate reports and perform queries. Unlike other application builders, PROGRESS FAST TRACK provides you greater flexibility and control by generating 4GL code.

For only \$95†, you can test drive a copy of PROGRESS. And if it's not as fast as we say it is, we'll refund your money. So call today. And hang on tight.

Send \$95† for your PROGRESS Test Drive.
Or call: Progress Software Corporation
5 Oak Park
Bedford, MA 01730
1-800-FAST 4GL
(In Massachusetts, call 617-275-4500)
FAX: 617-275-4595
Telex: 509965
(In Canada, call
416-620-6766)

PROGRESS® FASTEST FROM START TO FINISH.

Offices in: Atlanta, Boston, New York, San Diego, Washington, D.C., Amsterdam, Brussels, Cologne, Copenhagen, Helsinki, London, Melbourne, Montreal, Munich, Oslo, Paris, Reykjavik, Stockholm, Sydney, Toronto, Vienna, and Zurich.

\*DATAPRO Reports on Software, DATAPRO 70 © 1986, 1987, DATAPRO RESEARCH CORPORATION †For international orders please call for shipping and handling information.

PROGRESS and PROGRESS FAST TRACK are registered trademarks of Progress Software Corporation, developers of advanced Corporation (Seventher Corporation).

PROGRESS and PROGRESS FAST TRACK are registered trademarks of Progress Software Corporation, developers of advanced trademarks of Microsoft Corp.; CTOS of Convergent Technologies, Inc.; BTOS of Unisys Corporation.

of an undocumented process? I always play it safe by copying my files, including WIN.INI, to another directory before running the installation and then copying them back, but this is a tedious process that complicates and lengthens installation.

The other important enhancement in version 2.1 of Windows/286 and /386 is a more comprehensive list of supported devices. The number of printers has grown and now includes a variety of new laser printers, several of the

newer 24-pin, dot-matrix models, and even the Hewlett-Packard DeskJet, which is its new ink-jet printer.

Of greater interest are the supported displays. Windows/286 now includes the IBM 8514, with its 1,024-by-768 resolution. Windows/386 does not support the 8514, but Microsoft says that a future release will. Just as users in the Macintosh world love its big displays from Radius and SuperMac, PC users will crave screens like the 8514. Excel displays four times as many cells

on the 8514, so a worksheet with columns for each month of the year fits across the screen.

The additional device drivers are a contradiction of sorts. Microsoft officials have repeatedly said they were not in the business of writing drivers, and, in fact, the new package includes documentation suggesting you call any hardware vendor whose product is not directly supported by the supplied drivers. But Microsoft's latest message is: don't expect any drivers but the most important ones from us.

With Windows 2.1, Microsoft has pushed back the 640KB barrier, extending conventional memory by 64KB. Because many 286 and 386 machines are shipped with 1MB of memory already installed, and because they are restricted to 640KB, the remaining 384KB is usually allocated as extended memory. Windows is now able to use that memory to store its own code, thus freeing more conventional memory for applications. *PC Tech Journal* has not yet tested this new facility.

For Windows users, any increase in speed is worth the price of an upgrade. If you are using newly supported hardware, the upgrade is mandatory. Either way, the improvement is manifest and keeps Windows on a positive, forward course.

### **VENDOR SUPPORT**

In a continuing effort to build market demand, Microsoft showcased products from a variety of vendors when it announced the new versions of Windows. It distributed more than 50 press releases about products ranging from connectivity solutions such as Gupta Technologies' SQL Windows toolkit to COMPUSKETCH, a system from Visatex Corporation that allows law enforcement agencies to generate composite sketches of suspects.

While the mass of software for Windows is hardly a match for Macintosh, the increasing variety of products demonstrates the rising interest of developers. This is important for the Windows market, which needs a ready supply of applications in every category if it is to succeed. When I talked to Windows developers about the Apple suit, I asked how business was; everyone reported sales on the upswing.

Microsoft has yet to win over the whole world with Windows, but it certainly is making progress.



Will Fastie is the editorial director and founding editor of PC Tech Journal.

### Make a Great Impression

How do you make a great impression in an industry where everything is so impressive? We made it with the Graphics Solution, a multipurpose Monochrome-Color Graphics Card. Displaying Color Graphics, Games or the latest Software Applications on either Monochrome or RGB monitors are not the only features of the Graphics Solution. It's ease of use

which has made this card so attractive to hundreds of thousands of Computer users. The ability to display spreadsheets and word-processing in the wide screen format of 132 columns is another of its many impressive features. Uncomplicated and dependable, just what

you're looking for?
Check it out; even the ®
price will impress you.
Available at all
leading Computer
dealers.

CIRCLE NO. 171 ON READER SERVICE CARD

#### TECHNOLOGIES INC.

Technology you can Trust.

ATI Technologies Inc 3761 Victoria Park Ave Scarborough, Ontario, Canada M1W 3S2 Tel.: (416) 756-0711

Fax: (416) 756-0720

### TECH RELEASES

The latest in hardware, software, and technology for systems developers and integrators



PowerMate 386/20 from NEC Information Systems

#### **SYSTEMS**

Two additions have been made to **Compaq Computer Corporation**'s family of 386-based personal computers. The 32-bit **Compaq Deskpro 386s** features Intel's 16-MHz 386SX, a
1.2MB 5.25-inch diskette drive, VGA graphics controller, hard-disk drive interface, socket for the 387SX coprocessor, and 1MB of RAM. It also includes four 8/16-bit expansion slots, one high-speed memory expansion slot, an auxiliary input interface for use with a mouse or other pointing device, and parallel and asynchronous communications interfaces. Model 1 (no hard-disk



Compaq Deskpro 386s

drive), \$3,799; Model 20 (20MB hard-disk drive), \$4,499; Model 40 (40MB hard-disk drive), \$5,199.

The Compaq Deskpro 386/25, a 32-bit microcomputer based on Intel's 25-MHz 386, incorporates Intel's 25-MHz 82385 cache controller operating with Compaq Flex Architecture. (For a review of this machine, see "100 MHz of Performance," David Claiborne and Jim Shields, this issue, p. 66). Standard features of the Deskpro 386/25 include one 1.2MB 5.25-inch diskette drive, 1MB of 32-bit RAM, six expansion slots (four 8/16-bit and two 8-bit), and parallel and asynchronous communications

interfaces. Model 110 (110MB hard-disk drive), \$10,299; Model 300 (300MB hard-disk drive), \$13,299.

The Compaq 300/600MB Fixed Disk Drive Expansion Unit option features one standard and one optional full-height 300MB hard-disk drive. Two expansion units allow storage capability to reach 1.2GB. \$6,999.

Compaq Computer Corporation, 20555

Compaq Computer Corporation, 20555
FM 149, Houston, TX 77070;
713/370-670

CIRCLE 302 ON READER SERVICE CARD

The PowerMate 386/20, a microcomputer based on the 20-MHz Intel 386, has been introduced by NEC Information Systems Inc. The machine features zero wait states and supports as much as 16MB of 32-bit, 80-ns RAM. The base unit includes eight full-size expansion slots (one memory-dedicated 32-bit, five 8/16-bit, and two 8-bit); two RS-232C serial ports; one parallel printer port; and five 5.25-inch, halfheight internal-disk storage slots. As much as 600MB can be configured from options including 42MB, 130MB, or 300MB hard-disk drives (with 28-, 23-, and 18-ms access times, respectively). Options also include 1.2MB and 360KB 5.25-inch, and 720KB and 1.44MB 3.5-inch diskette drives (with 5.25-inch form factors). Base unit with 2MB of RAM, from \$5,795. NEC Information Systems Inc., 1414 Massachusetts Avenue, Boxborough, MA

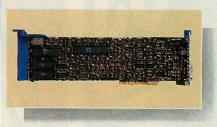
Massachusetts Avenue, Boxborough, MA 01719; 800/343-4418; 617/264-8000 CIRCLE 301 ON READER SERVICE CARD

#### CONNECTIONS

An intelligent multiprotocol datacommunications coprocessor board for IBM PS/2 microcomputers is shipping from **Emulex Corporation**. The **DCP-186/MC** board incorporates a communications coprocessor engine, a serial RS-232C I/O daughterboard with parallel printer port, and an I/O cable assembly. The Micro Channel Intelligent Communications Coprocessor Engine (MICCE) contains an on-board, 10-MHz 80C186 with 128KB or 512KB of memory. It supports four half- or full-duplex RS-232C serial ports (synchronous or asynchronous) with two channels of DMA and a high-speed, Centronics-compatible parallel printer port. Prices start at \$1,595.

Emulex Corporation, 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626; 800/368-5393; 714/662-5600 CIRCLE 309 ON READER SERVICE CARD

An addition to **IDEAssociates Inc.**'s PC-to-System-3*x* communications line, **IDEAcomm 5251/Plus** offers seven concurrent host sessions and windowing. Software enhancements to the



IDEAcomm 5251/Plus from IDEAssociates

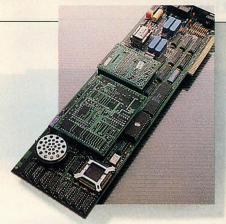
IDEAcomm 5251 product line have also been announced, including IBM 3196 terminal emulation, IBM 4214 system printer emulation, and multiple-system printer emulation. IDEAcomm 5251/ Plus, \$1,095; upgrade (including enhanced software), \$200. **IDEAcomm** 5251 5.0, \$895; upgrade, \$80. *IDEAsociates Inc., 29 Dunham Road, Billerica, MA 01821; 800/257-5027;* 617/663-6878

CIRCLE 311 ON READER SERVICE CARD

NetWare LAN operating system support for the Apple Macintosh computer will be available from **Novell Inc.** in the fourth quarter of 1988. **NetWare for Macintosh** is AppleShare-compatible







Intel's Connection CoProcessor add-in board with modem option

and allows users of Macintoshes in an AppleTalk Network System to become fully NetWare-compatible. Because each workstation continues to use its native workstation operating system, users of Macintosh or IBM PC and PS/2 workstations can continue to operate in their environments, while sharing files and data transparently across the network. Macintosh users can obtain the fault tolerance, security, and performance of NetWare 2.15, along with access to the cost/performance benefits of an IBMcompatible file server (which under NetWare can provide as much as 2GB of mirrored disk storage). For use with existing NetWare 2.15 or later, \$200. Novell Inc., 122 E. 1700 South, Provo, UT 84601; 800/453-1267; 801/379-5900

CIRCLE 313 ON READER SERVICE CARD

Intel Corporation's Personal Computer Enhancement Operation (PCEO) and a group of leading software developers have jointly announced support for a standard communications programming interface that allows software developers to incorporate transparent background communications into their applications. The Intel Communicating Applications Specification (ICAS), when used with supported hardware, allows applications to send and receive files between PCs and facsimile machines.

Intel PCEO also has introduced Connection CoProcessor, the first of several families of Intel communications products supporting ICAS. The Connection CoProcessor add-in board provides intelligent communications over phone lines for tasks such as high-speed file transfer, facsimiles, and E-mail. Its multicommunications coprocessor uses a 10-MHz 80188 and 256KB of memory, allowing it to operate intelligently in the background. The board also has a piggyback site to allow expansion. \$995.

Connection CoProcessor's plug-in site supports a family of communications options, including the Connection CoProcessor 2400B Modem **Option**, a 2,400-bps Hayes-compatible modem that uses an Intel 89024 chip set. Connection CoProcessor software provides the ability to send and receive files, facsimiles, and simple E-mail using point-and-shoot menus with optional mouse support. Modem \$295. Intel Corporation PCEO, Mail Stop CO3-07, 5200 N.E. Elam Young Parkway, Hillsboro, OR 97124-6497; 800/538-3373; 800/235-0444 (Canada); 503/629-7354

CIRCLE 310 ON READER SERVICE CARD

A family of LAN products for small-tomidsize network requirements is available from EasyNet Systems. The EasyNet 116 LAN includes a communications board and software that permits peer-to-peer network communications at speeds as high as 1.5 Mbps over twisted-pair cable. All PCs remain func-



EasyNet II from EasyNET Systems

tional as workstations; the network can be expanded to include as many as 25 stations. EasyNet 116 starter kit with all necessary hardware, software, tap boxes, and cabling for a two-station network, \$795; hardware and software per station, \$395.

Other products announced by EasyNet are PS POST, a full-featured E-mail system; EasyNet II, a zero-slot LAN that allows two PCs to share resources such as printers and hard-disk drives; and EasyNet NOS/2, which provides a network operating system that can be used in conjunction with any NETBIOS-compatible network adapter board. The EasyNet NOS/2 system is compatible with Arcnet, Ethernet, and twisted-pair adapter boards and supports NETBIOS-compatible gateway products. PS POST, \$199; EasyNet II, \$169; EasyNet NOS/2, \$1,195. EasyNet Systems Inc., 4283 Village Centre Court, Mississauga, Ontario L4Z 1S2, Canada; 800/387-3207; 416/273-6410

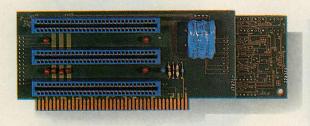
CIRCLE 315 ON READER SERVICE CARD

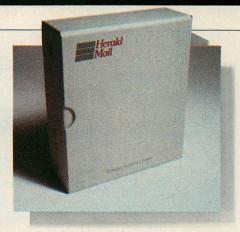
Tri-Data Systems Inc. offers the Netway 1000/PC, a LAN-based gateway that allows both PCs and Macintoshes coresiding on an AppleTalk network to communicate with an IBM mainframe computer. The Netway 1000/PC consists of 3274 emulation hardware and 3270 workstation software, enabling users to access mainframe functions. It permits full-function host file transfer, facilitates both local and remote 3287 printing to a laser printer, and permits users to log on to as many as six host sessions on the PC and eight host sessions on the Macintosh. \$3,995.

Tri-Data Systems Inc., 1450 Kifer Road, Sunnyvale, CA 94086; 408/746-2900 CIRCLE 314 ON READER SERVICE CARD

Eicon Technology Corporation is offering NetBIOS Remote Bridge, NetBIOS Bridge/X.25, and NetBIOS Remote PC/X.25, products that connect two or more NETBIOS-compatible LANs and PCs over switched lines and X.25 packet-switched networks at speeds as high as 64 Kbps. The IBM PC, PS/2, or compatibles on the LAN have access to the bridging software. Once a connection is established, remote LAN resources are accessed as if they are on one network. NetBIOS

37 SEPTEMBER 1988





XRAM expanded memory board with daughterboard (front) from CEI

Emissary System's Herald Mail

Bridge/X.25 and NetBIOS Remote PC/X.25 run concurrently with Eicon Technology's gateways, Access/X.25 or Access/QLLC, allowing users to maintain access to IBM mainframes, System/3x, ASCII hosts, and public databases, while communicating to remote LANs over the same X.25 link. NetBIOS Remote Bridge, \$1,995; NetBIOS Bridge/X.25, \$1,400. NetBIOS Remote APC/X.25: stand-alone version, \$100; LAN version, \$400.

Eicon Technology Corporation, 2196 32nd Avenue (Lachine), Montreal, Quebec, Canada H8T 3H7; 514/631-2592

CIRCLE 312 ON READER SERVICE CARD

An E-mail package for PC LANs, Herald Mail, has been announced by Emissary Systems Limited. The system is built directly on IBM's SNA Distribution Services (SNADS) for transparent interfacing to IBM mainframes without requiring proprietary hardware or software. Herald Mail uses a Lotus-style interface; users can send and receive messages or DOS files of any size, choosing the addresses from a mail directory that shows both individual users and distribution lists. Features include in-tray and out-tray functions; confirmation of delivery; mail-notification; and mail libraries. For any number of users on a single LAN, \$6,995. Emissary Systems Limited, 130 Bloor Street West, Suite 1002, Toronto. Ontario, Canada M5S 1N5; 416/920-9001

#### **PERIPHERALS**

A video-graphics subsystem manufactured by **Hewlett-Packard Company** offers more colors, sharper text and graphics, and faster processing of images. The subsystem includes either the **HP video-graphics color display**, which displays as many as 256 colors

simultaneously, or the **HP monochrome video-graphics display**, which shows as many as 64 shades of gray, and the **HP video-graphics adapter** (HP VGA), which operates with either monitor.

The HP VGA has an 800-by-600 pixel resolution, can display 132 columns of text on a single line, and is



Video-graphics color display from Hewlett-Packard

compatible with software written for the IBM VGA, EGA, CGA, and MDA as well as Hercules monochrome adapters. It comes standard with 256KB of RAM (expandable to 512KB for 640-by-480 pixel resolution). HP video-graphics color display, \$695; HP monochrome video-graphics display, \$250; HP VGA, \$445.

In addition, an **HP Touchscreen Plus** touch accessory is available as an option for the HP video-graphics color display. \$530.

Hewlett-Packard Company, 3000 Hanover Street, Palo Alto, CA 94303-0890; contact the Hewlett-Packard sales office listed in the telephone directory white pages

CIRCLE 306 ON READER SERVICE CARD

The **Elkey-4**, an electronic-key security board for the IBM PC, PC/XT, PC/AT, and compatible computers, and the **Elkey-4M**, a version for the IBM PS/2,

have been released by **Computer Elektronik Infosys of America Inc.**(CEI). When the boards are installed, part of the boot sector from the hard disk is removed to the boards, and the hard disk cannot be accessed even if the machine is booted from the diskette drive. The security products regulate access, perform encryption using the latest data encryption standard (DES) chip, and permit user control and restriction of the machine's resources. \$839 each.

CEI also offers an expanded memory board for the IBM PS/2 Model 30 that does not take up one of that machine's three expansion slots. The XRAM consists of two boards connected together; one replaces the IBM three-slot board that plugs to the system board, and the second is a daughterboard with space for 2MB of expanded memory that connects to the replacement slot board. XRAM supports EMS 3.2, EEMS, and EMS 4.0. The basic version comes with 1MB of memory and expansion slots for an additional 1MB. \$999; 2MB version \$1,359. Computer Elektronik Infosys of America Inc., 512-A Herndon Parkway, Herndon, VA 22070; 800/322-3464; 703/435-3800

CIRCLE 305 ON READER SERVICE CARD

A 778MB 5.25-inch Winchester disk drive has been announced by the Computer Products Group of Fujitsu America Inc. The M2263E offers a data-transfer rate of 1.87MB per second and an average positioning time of 16 ms. The drive features spindle synchronization capability to adapt it for drive clustering and disk-array applications, 8 sputtered thin-film metal media platters, and 15 monolithic-type ferrite read/write data heads. Additional specifications include a 31,296-byte track capacity, 1,658 cylinders, and a MTBF rate of 30,000 hours. A dedicated servo surface allows users to select sector

## Fast database development system with SQL-based db\_QUERY and Lotus 123 interface...

FAST • PORTABLE • ROYALTY-FREE

PROGRAMMERS-We asked what you wanted in a database development system and we built it!

**db\_VISTA III™** is the database development system for programmers who want powerful, high performance DBMS capabilities ... and in any environment. Based on the network database model and the B-tree indexing method, db\_VISTA III gives you the most powerful and efficient system for data organization and access. From simple file management to complex database structures with millions of records. db\_VISTA III runs on most computers and operating systems like MS-DOS, UNIX, VAX/VMS and OS/2. It's written in C and the complete source code is available, so your application performance and portability are guaranteed! With db\_VISTA III you can build applications for single-user microcomputers to multi-user LANs, up to minis and even main-

#### ne db\_VISTA III™ Database Development System

db\_VISTA™: The High Performance DBMS 2 db\_QUERY:™ The SQL-based Query.

e major features include: Multi-user support for LANs and multi-user computers.

Multiple database access.

frames.

File and record locking. Automatic database recovery

Transaction processing and logging. Timestamping. Database consistency check utility.

Fast access methods based on the network database model and B-tree indexing. An easy-to-use interactive database access

utility. File transfer utilities for importing/export-ing ASCII text and dBASE II/III files.

A Database Definition Language patterned after C

Virtual memory disk caching for fast database access

A runtime library of over 100 functions.

- Provides relational view of db\_VISTA applications.
- Structured Query Language
- C linkable.
- Predefine query procedures or run ad-hoc queries "on the fly"
- db\_REVISE": The Database Restructure Program.
- Redesign your database easily. Converts all existing data to revised design
- WKS Library for Lotus 123.
- C-linkable interface to Lotus files.
- Operating systems: MS-DOS, UNIX V, XENIX, VMS, OS/2.
- C Compilers: Lattice, Microsoft, IBM, Aztec, Computer Innovations, Turbo C, XENIX, and UNIX.
- LAN systems: LifeNet, NetWare, PC Network, 3Com, SCO XENIX-NET, other NET-BIOS compatible MS-DOS networks.

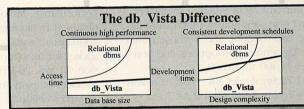
ll components feature royalty-free run-time distribution, source code vallability and our commitment to customer service. That's why cor orations like ARCO, AT&T, Hewlett-Packard, IBM, Northwestern lutual Life, UNISYS and others use our products.

PROFESSIONAL SERVICES: In addition to 60 days of FREE technical support, we offer complete services to get your development project going and keep it on track:

Training Classes • Extended Support • Applications Development & C Programming Services • Consulting • Database Design & Optimization • Product Modification

We're committed to making your database project a success!

HOW TO ORDER: Call us; we'll help determine your needs and get you started. Add components as you need them. Ask about the new Lotus interface. . . Call today!



#### db\_VISTA III™ Database **Development System**

db\_VISTA III " db\_QUERY" db\_REVISE" db\_VISTA™ File Manager WKS Library for Lotus 123 \$595 - 3960 \$595 - 3960

\$595 - 3960

Starts at \$195

When high quality data base applications with outstanding performance are important to your company's success:



CALL 1-800-db-RAIMA VISA



(that's 1-800-327-2462)

In the UK call Systemstar Ltd. 0992-500919



3055 112th Avenue N.E. #100 Bellevue, WA 98004 (206) 828-4636 Telex: 6503018237MCIUW FAX: (206) 828-3131 CIRCLE NO. 176 ON READER SERVICE CARD

#### TECH RELEASES



Linus Write-Top handwriting recognition system



VGA/20 color monitor from Aydin Controls

sizes in two-byte increments. The M2263E is available with an ESDI or embedded SCSI interface. In 100-unit quantities, \$3,170 each.

Fujitsu America Inc., Computer Products Group, 3055 Orchard Drive, San Jose, CA 95134; 408/432-1300 CIRCLE 303 ON READER SERVICE CARD

Linus Technologies Inc. has unveiled its Linus Write-Top, a handwriting-recognition system that allows users to write directly on a display screen. The Linus Write-Top is based on a transparent digitizer that overlays a flat-panel display and a symbol-recognition algorithm that learns and recognizes any handwritten symbols and converts them into ASCII. Weighing nine pounds, the Linus Write-Top is a portable, DOS-based tool with 640KB of internal CMOS SRAM, a memoryboard port, optional 3.5-inch diskette drive and modem, and keyboard interface. Depending on options and software, \$2,400 to \$3,600.

Linus Technologies Inc., 1889 Preston White Drive, Reston, VA 22097; 703/476-1550

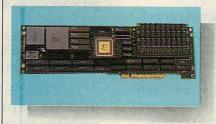
CIRCLE 307 ON READER SERVICE CARD

The **Patriot VGA/20**, a 20-inch VGA color monitor, is offered by **Aydin Controls**. The monitor offers compatibility with all modes of the IBM VGA standard (including the 8514/A), and allows resolutions as high as 1,024-by-768 pixels, with 256 colors. The VGA/20 features automatic picture sizing and provides full-screen displays in all VGA modes and refresh rates of 60, 70, and 87 Hz. \$2,545.

Aydin Controls, 414 Commerce Drive, Fort Washington, PA 19034-2602; 800/366-8889; 215/542-7800 CIRCLE 308 ON READER SERVICE CARD

The Aox PS/2 80386 processor upgrade card for 286-based IBM PS/2 Models 50 and 60 that takes advantage

of the multimaster capabilities of Micro Channel architecture is being manufactured by **Aox Inc.** The product will be available in the fourth quarter of 1988 in 16-, 20-, and 25-MHz versions. Its cache-based design uses all existing system memory, and as much as 8MB of 32-bit, dual-ported memory can be added directly to the board to supplement existing memory and optimize



PS/2 processor upgrade card from Aox

performance. Multiprocessing can be obtained by adding Aox cards with appropriate software. The card has a socket for an optional 387. 16-MHz version, \$1,595; 20-MHz version, \$1,895; contact company for the price of the 25-MHz version.

Aox Inc., 486 Totten Pond Road, Waltham, MA 02154; 617/890-4402 CIRCLE 304 ON READER SERVICE CARD

#### SOFTWARE DEVELOPMENT

LynxOS, a UNIX-compatible operating system that gives realtime capabilities to 32-bit microcomputers such as the Motorola 68000 processor family, the Intel 80386, and RISC processors, is being shipped by Lynx Real-Time Systems Inc. LynxOS runs existing UNIX application software, provides a familiar software development environment, and supports a fully preemptable kernel with minimal interrupt disabling. The system uses prioritized, preemptive scheduling: the highest-priority task that is not waiting for resource usage or I/O has the CPU. Source code

license for LynxOS (initial CPU), \$65,000; additional CPU, \$20,000; onetime sublicensing fee, \$25,000; royalty per copy, \$150.

Lynx Real-Time Systems Inc., 550 Division Street, Campbell, CA 95008; 408/370-2233

CIRCLE 317 ON READER SERVICE CARD

C programmers can expand their capacity to design, test, and understand complex programs using **Sherlock**, from **Edward K. Ream.** Sherlock consists of C language macros and support routines called by those macros; the macros are inserted by hand or automatically with the SPP tool included with Sherlock. These macros define named code boxes that conceal tracing and debugging code until the code is needed. Other features include a built-in profiling capability and three utility programs. Complete C source code is provided. \$125.

Edward K. Ream, 1617 Monroe Street, Madison, WI 53711; 608/257-0802 CIRCLE 318 ON READER SERVICE CARD

Shannon Associates Inc. offers META-MORPHOSIS, a generic utility program that translates any source program from one language to another, given the syntactical definition of the source and target languages. METAMORPHOSIS also functions as a custom compiler, assembler, macro processor, query-language processor, and report generator. The program facilitates reformatting of database files and analysis of natural language, grammar, sequential and parallel procedures, and computational signatures. \$387.

Shannon Associates Inc., P.O. Box 597,

Shannon Associates Inc., P.O. Box 597, Chapel Hill, NC 27514; 919/929-6863 CIRCLE 320 ON READER SERVICE CARD

A development tool for simplifying the design of user interfaces is available from **Black & White International**Inc. FaceIt allows programmers to

Continued on p. 49

# Accelerate.



# Now there's room for everyone on the fast track.

Compaq introduces the best of 80386 technology for every computer user.





When Compaq pioneered high-performance personal computing and introduced the industry's first 32-bit PC's based on the Intel\* 386\* chip, we gave performance-hungry business users, engineers, analysts and software developers the tools they needed to run complex applications faster and better.



Now, we're introducing the new COMPAQ DESKPRO 386S and COMPAQ DESKPRO 386/25. And extending our high-performance 80386 line in both directions. To meet the increasing demands of today's general business users and to provide our power users with more power than ever. So everyone can enjoy the speed and future capabilities of 80386 computing.

In each COMPAQ 80386 PC, our exclusive design lets every component operate at optimum speed. Giving COMPAQ personal computers a considerable edge in system performance, ensuring compatibility with industry-standard software and hardware, and providing what may well be the ultimate in connectivity for

high-performance, network environments. The new COMPAO DESKPRO 386s

is the first personal computer designed specifically to let general business PC users head straight for the performance and potential of 80386 personal computing.

For more advanced applications, the original COMPAQ DESKPRO 386 and the COMPAQ DESKPRO 386/20 deliver even higher levels of performance.

And now at the top of our line is the COMPAQ DESKPRO 386/25. The most powerful personal computer available.

With our two newest machines, we're not just pushing 80386 technology forward; we're widening it. To let every personal computer user take advantage of everything COMPAQ 80386 power has to offer.



It simply works better.

Now, breakthrough technology from Compaq brings the power and potential of 80386-based personal computing to millions of business PC users. The first personal computer powered by the new Intel 386SX\* microprocessor, the new COMPAQ DESKPRO 386S is designed specifically as an affordable, high-performance alternative to 80286-based PC's.

Surrounding its revolutionary microprocessor are high-performance components and a 32-bit architecture that run your current software up to 60% faster than most 10-MHz 80286 PC's. Plus give you the power to run 32-bit software that 80286 PC's won't run at all. And exciting new multitasking software such as

Microsoft\* Operating System/2 from Compaq and Microsoft Windows/386.

With its sleek, "small footprint" design, the COMPAQ DESKPRO 386s takes up far less room than its competition.

But it gives you room for four internal storage devices.



So you can easily tailor it to your exact needs. Choose from fast 20-, 40-, and 110-Megabyte Fixed Disk Drive options; 51/4-inch and 31/2-inch diskette drives; even tape backup options.

We give you one full megabyte of high-speed memory standard. And you can expand to 13 megabytes without using an expansion slot. This will come in handy when you're ready to thoroughly exploit the MS° OS/2 operating system and advanced 80386 business software.

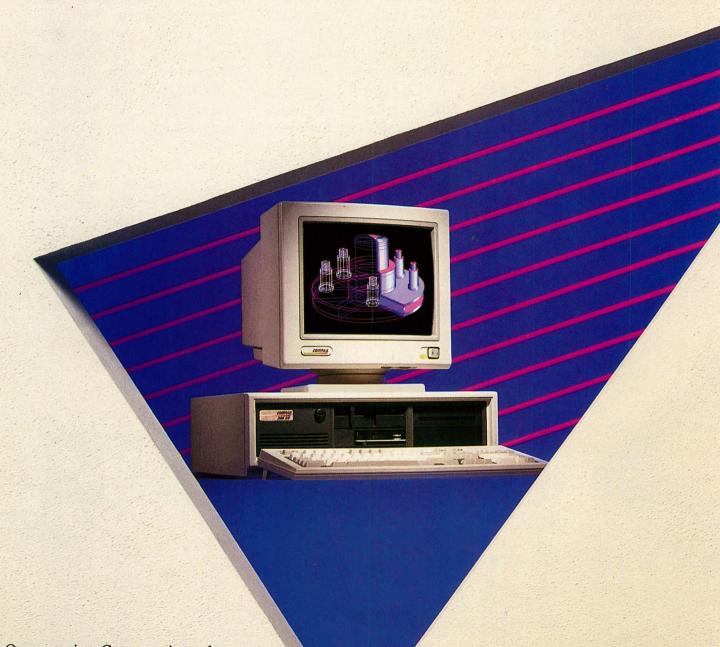
We even built features like advanced VGA graphics and standard interfaces for a mouse, printers and other peripherals into the system. This saves your slots for modems, network boards and much more.

You'll also find two more standard features: the same sophisticated engineering and uncompromising quality that set all COMPAQ 80386 computers apart. So head for the performance you really need for today's applications. And the 80386 potential you'll need for tomorrow's. With the new COMPAQ DESKPRO 386S.

# Get into the passing lane.

Introducing the COMPAQ DESKPRO 386s. New technology delivers affordable 80386 performance for anyone considering 80286 PC's.

COMPAQ



Once again, Compaq introduces a personal computer that leaves every other PC in the dust. With its unsurpassed Intel 25-MHz 386\* microprocessor, exclusive COMPAQ Flexible Advanced Systems Architecture, and up to 1.2 gigabytes of storage, the new COMPAQ DESKPRO 386/25 is the ultimate expression of 80386 technology.

Its FLEX Architecture uses separate memory and peripheral buses operating in concert to reach maximum system performance, while maintaining compatibility with industry-standard hardware and software. By splitting

the work, they also prevent information bottlenecks in the system.
The 25-MHz cache memory controller keeps data instantly accessible, and that lets the processor tear through applications with 0 wait states 95% of the time.

All this translates into performance

All this translates into performance that's up to 60% faster than most 20-MHz 80386-based PC's.

And, with the optional Intel 387\* or Weitek<sup>TM</sup> coprocessor, you'll even be able to match the numeric processing power of a dedicated engineering workstation at a fraction of the cost.

# fasten your seat belt.

Introducing the 25-MHz COMPAQ DESKPRO 386/25. The most powerful personal computer available.

You can go from one megabyte of standard, high-speed memory all the way to 16 megabytes. And for storage-hungry applications, such as networks using disk fault tolerance and multiuser systems, the COMPAQ DESKPRO 386/25, with two optional COMPAQ 300-/600-Megabyte Fixed Disk Drive Expansion Units, is able to provide up to a massive 1.2 gigabytes of high-performance storage. With an average access time as low as 20 milliseconds.

Of course, we give you a choice of  $5^{1/4}$ " or  $3^{1/2}$ " diskette drives and high-capacity tape backup options.

For sophisticated PC users who require the ultimate in power, compatibility, connectivity and overall system performance, no other personal computer comes close to the new COMPAQ DESKPRO 386/25.

It's simply the most powerful personal computer available. But then, that's what Compaq users have come to expect. Again and again and again.

COMPAG

It simply works better.

# Full speed ahead

Next to high performance, the advantage of COMPAQ 80386 computing is compatibility with both today's and tomorrow's software. From MS-DOS\* to the exciting new MS OS/2 operating system. And beyond.

Thanks to a close and longstanding working relationship between Compaq and the industry's independent software developers, the COMPAQ line of 80386 personal computers is especially capable of letting you tap the full potential of all the new multitasking software.

You'll run MS-DOS 3.3, plus MS OS/2, Microsoft Windows/386, XENIX°, UNIX° and the thousands of applications written for them. And with any computer from the COMPAQ 80386 line, you'll run them all faster.

Take one for a quick spin and you'll see why COMPAQ computers earn unsurpassed satisfaction ratings from users and industry experts. For the location of the nearest Authorized COMPAQ Computer Dealer or for more details, call 1-800-231-0900. Ask for Operator 63. In Canada, call 1-800-263-5868, Operator 63.

MS. Windows/386

COMPAQ® and COMPAQ DESKPRO 386® are trademarks of Compaq Computer Corporation. Microsoft, MS-DOS, XENIX® and MS® are trademarks of Microsoft Corporation. MS® OS/2 and MS® Windows/386 are products of Microsoft Corporation. Product names mentioned herein may be trademarks and/or registered trademarks of their respective companies. \*Registered U.S. Patent and Trademark Office. COMPAQ DESKPRO 386/25 graphics ©1988 Accent Software, Inc. ©1988 Compaq Computer Corporation. All rights reserved.

MS-DOS

\*Hereafter referred to as 80386SX, 80386 and 80387 respectively.

It simply works better.





Screen from Tri-Technology's 4c

PROGRESS 4GL language and data-management system

create pull-down and Lotus-style menus, data-entry tables, and pop-up and context-sensitive help windows from existing .DBF and ASCII files, without the need to specify coordinates, draw a window, and type in text. Capabilities include automatic multiple-column menus, built-in scrolling, screen-placement, and design of interfaces from DOS. \$99.

Black & White International Inc., P.O. Box 21108, New York, NY 10129; 212/787-6633

CIRCLE 322 ON READER SERVICE CARD

**The Iliad Group** has announced the **PI 2.0**, a multilanguage program editor that includes an enhanced macro language and integrated source-level debugger. PI 2.0 has a pop-up menu that allows the user to single-step, browse the macro, and edit the macro instructions during execution. Breakpoints can

PIEDIT

PI 2.0 editor from The Iliad Group

be encoded in source to suspend macro execution. The editor has a context-sensitive cursor, support for any size screen, and a feature that allows the user to find and gather all lines that contain a search string. The Iliad Group, 2697 Union Street, San Francisco, CA 94123; 415/563-2053

CIRCLE 319 ON READER SERVICE CARD

A hypertext editor that simplifies C programming has been released by Tri-Technology Systems Inc. The 4c editor includes a C source-code analyzer that cross-references functions and variables to their respective path and file names; the cross-reference table can be displayed alphabetically and by type of variable. The programmer can edit functions directly without specifying a file name. Other features include cut and paste, search and replace, auto-indent, tab support, and multiple windows. 4c uses a familiar user interface with pull-down menus, works with any C compiler, and requires no changes to source code. \$89. Tri-Technology Systems Inc., 1400 S. Central Avenue, Cicero, IL 60650; 312/366-7595

CIRCLE 321 ON READER SERVICE CARD

Nu-Mega Technologies has introduced MagicCV, an add-on to Microsoft's CodeView debugger that reduces CodeView's conventional memory requirements from more than 200KB to less than 8KB. MagicCV requires an 80386-based PC; it uses the virtualmachine capabilities of the 386 to run CodeView and program symbols in a separate virtual machine in extended memory. MagicCV can coexist with Nu-Mega's Soft-ICE, a debugger that provides realtime break-point capabilities not available in CodeView. \$199. Nu-Mega Technologies, P.O. Box 7607, Nashua, NH 03060-7606; 603/888-2386

CIRCLE 323 ON READER SERVICE CARD

#### **DATA MANAGERS**

SQL support has been included in **Progress Software Corporation**'s fourth-generation language (4GL) and data management system, **PROGRESS**. Progress software is structured to accept both SQL and PROGRESS statements

in the same procedure; developers can use pure SQL syntax, regular progress syntax, or mix and match both types of syntax. Users can edit and change SQL statements using the built-in progress 4GL editor. Depending on host computer, \$1,000 to \$125,000.

Progress Software Corporation, 5 Oak Park, Bedford, MA 01730; 800/327-8445; 617/275-4500

CIRCLE 325 ON READER SERVICE CARD

Realia Inc. and XDB Systems Inc. have jointly announced the XDB SQL **COBOL Preprocessor**, which allows Realia COBOL applications to take advantage of XDB relational database technology and the SQL language. An XDB-developed COBOL precompiler permits the programmer to embed SQL statements in Realia COBOL applications (compatible with IBM VS COBOL) and then converts these statements to subroutine calls to the SQL-based XDB product. Applications programs thus can communicate with XDB's SQL engine to access, modify, and manipulate data stored in XDB databases. XDB SQL COBOL Preprocessor, \$395; Realia COBOL compiler, \$995; XDB as a database server, \$1,995. Realia Inc., 10 S. Riverside Plaza, Chicago, IL 60606; 312/346-0642

CIRCLE 328 ON READER SERVICE CARD

XDB Systems Inc., 7309 Baltimore

Avenue, Suite 220, College Park, MD

20740; 301/779-5486

CIRCLE 329 ON READER SERVICE CARD

A PC-based interface to any relational or hierarchical database residing on any system (mainframe, minicomputer, or microcomputer) is offered by **Pantheon-Delphic Systems Inc**. The **Pantheon Development and Delivery System** is an intelligent database-access system that allows access to multiple databases without requiring knowledge of the query language, data structure, or contents of the given data-

SEPTEMBER 1988

### PolyAWK - The Toolbox Language.

For C, Pascal, Assembly & BASIC Programmers.

We call PolyAWK our "toolbox" language because it is a general-purpose language that can replace a host of specialized tools or programs. You will still use your standard language (C, Pascal, Assembler or other modular language) to develop applications, but you will write your own specialized development tools and programs with this versatile, simple and powerful language. Like thousands of others, you will soon find PolyAWK to be an indispensable part of your toolbox.

#### A True Implementation Under MS-DOS

Bell Labs brought the world UNIX and C, and now professional programmers are discovering AWK. AWK was originally developed for UNIX by Alfred Aho, Richard Weinberger & Brian Kernighan of Bell Labs. Now PolyAWK gives MS-DOS programmers a true implementation of this valuable "new" programming tool. PolyAWK fully conforms to the AWK standard as defined by the original authors in their book, *The AWK Programming Language*.

#### A Pattern Matching Language

PolyAWK is a powerful pattern matching language for writing short programs to handle common text manipulation and data conversion tasks, multiple input files, dynamic regular expressions, and user-defined functions. A PolyAWK program consists of a sequence of patterns and actions that tell what to look for in the input data and what to do when it's found. PolyAWK searches a set of files for lines matched by any of the patterns. When a matching line is found, the corresponding action is performed. A pattern can select lines by combinations of regular expressions and comparison operations on strings, numbers, fields, variables, and array elements. Actions may perform arbitrary processing on selected lines. The action langauge looks like C, but there are no declarations, and strings and numbers are builtin data types.

#### Saves You Time & Effort

The most compelling reason to use PolyAWK is that you can literally accomplish in a few lines of code what may take pages in C, Pascal or Assembler. Programmers spend a lot of time writing code to perform simple, mechanical data manipulation — changing the format of data, checking its validity, finding items with some property, adding up numbers and printing reports. It is time consuming to have to write a special-purpose program in a standard

PolyAWK Comes With The Definitive Book On AWK...

Programming Language

PolyAWK

Requires
MS-DOS
2.0 or above & 256K RAM.

\$99

When you order PolyAWK you receive a copy of *The AWK Programming Language* written by the authors of the original UNIX-based AWK. The book begins with a tutorial that shows how easy AWK is to use, followed by a comprehensive manual. Because PolyAWK is a complete implementation of AWK as defined by the book's authors, you will use this book as the manual for PolyAWK.

You can purchase PolyAWK and the book, *The AWK Programming Language*, for \$99. If you already have the book, you can order PolyAWK software only for \$85, which is \$14 off the regular \$99 purchase price. (The book serves as the User's Manual, so you you should already have a copy of the book if you are ordering the software only.)

#### **PolyShell Bonus!**

PolyShell gives you 57 of the most useful UNIX commands and utilities under MS-DOS in less than 20K. You can still use MS-DOS commands at any time and exit or restart PolyShell without rebooting. MS-DOS programmers — discover what you have been missing! UNIX programmers — switch to MS-DOS painlessly! PolyShell and PolyAWK are each \$99 when ordered separately. Save \$50 by ordering the PolyShell + PolyAWK combination package for \$149. Not copy-protected.

#### 30-Day Money Back Guarantee

Credit Card Orders:

1-800-547-4000

Ask for Dept. PTJ Send Checks and P.O.s To: POLYTRON Corporation 1700 NW 167th Place, Beaverton, OR 97006 (503) 645-1150 — FAX: (503) 645-4576 language like C or Pascal each time such a task comes up. With PolyAWK, you can handle such tasks with very short programs, often only one or two lines long.

#### Prototype With PolyAWK, Translate To Another Language

The brevity of expression and convenience of operations make PolyAWK valuable for prototyping even large-sized programs. You start with a few lines, then refine the program, experimenting with designs by trying alternatives until you get the desired result. Since programs are short, it's easy to get started and easy to start over when experience suggests a different direction. PolyAWK has even been used for software engineering courses because it's possible to experiment with designs much more readily than with larger languages. It's straightforward to translate a PolyAWK program into another language once the design is right.

#### **Very Concise Code**

Where program development time is more important than run time, AWK is hard to beat. These AWK characteristics let you write short and concise programs:

- The implicit input loop and the pattern-action paradigm simplify and often entirely eliminate control flow.
- Field splitting parses the most common forms of input, while numbers and strings and the coercions between them handle the most common data types.
- Associate arrays use ordinary strings as the index in the array and offer an easy way to implement a single-key database.
- Regular expressions are a uniform notation for describing patterns of test.
- Default initialization and the absence of declarations shorten programs.

#### Large Model Implementation

PolyAWK is a large model implementation and can use all of available memory to run big programs or read files greater than 64K.

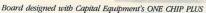
#### **Math Support**

PolyAWK also includes extensive support for math functions such as strings, integers, floating point numbers and transcendental functions (sin, log, etc.) for scientific applications. Conversion between these types is automatic and always optimized for speed without compromising accuracy.

R









ORACLE Quicksilver screen

base. Pantheon Developer, \$4,995; Delivery System, \$495; hierarchical or relational toolkit (allows developers to access the Pantheon System engine through their own interface), \$1,195. Pantheon-Delphic Systems Inc., P.O. Box 1115, 1301 Shoreway Road, Belmont, CA 94002; 800/262-6632; 415/593-6612

CIRCLE 326 ON READER SERVICE CARD

Under an agreement between Oracle Corporation and WordTech Systems Inc., Oracle will market SQL-based versions of WordTech Systems' dBASE III PLUS-compatible products—dBXL and Quicksilver-in the first quarter of 1989. ORACLE Quicksilver and ORACLE dBXL will allow users of dBASE programs full access to Oracle SQL databases simultaneously with dBASE files. It will support embedded SQL and automatic dbase-to-oracle file conversion, resulting in transparent support of existing dbase applications against ORACLE relational databases. Contact the company directly for price information. Oracle Corporation, 20 Davis Drive, Belmont, CA 94002; 415/598-8000 CIRCLE 324 ON READER SERVICE CARD WordTech Systems Inc., 21 Altarinda Road, Orinda, CA 94563; 415/254-0900

Online/Database Software Inc. has announced Release 2.2 of TAB/NET, a LAN version of The Application Builder (TAB), a PC-based data management tool for application program developers. TAB/NET includes an enhanced database structure to make it more efficient in a network environment by permitting more transactions across the network. TAB/NET offers full record locking and journal capabilities; provides standard SQL Query and Reporter Writer; includes multidata dictionaries and multidatabases; and allows dialog, map, table, and application generation using

CIRCLE 330 ON READER SERVICE CARD

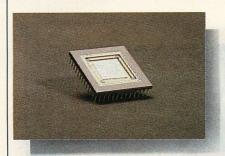
TAB's internally written compilers and C language support. For 8 LAN users, \$42,000; price for each additional workstation (serving as many as 64 users) is based on a sliding scale.

Online/Database Software Inc., One Blue Hill Plaza, Pearl River, NY 10965; 914/735-1515

CIRCLE 327 ON READER SERVICE CARD

#### **TECHNOLOGY**

Weitek Corporation has released 20and 25-MHz single-chip versions of its three-chip 1167 coprocessor for 80386based PCs. The **Abacus** math coprocessor plugs into the 121-pin extended math-coprocessor socket, which provides the capability to install the Intel 80387, the Abacus, or both coprocessors with Weitek's **Abacus daughter-**



Weitek's Abacus math coprocessor

**board**. The Abacus is supported under DOS, real and protected mode, and UNIX System 3.0 by C, FORTRAN, and Pascal optimizing compilers. OEM prices for 5,000 units: 20-MHz Abacus chip, \$445; 25-MHz Abacus chip, \$882; Abacus daughterboard, \$595. Weitek Corporation, 1060 E. Arques Avenue, Sunnyvale, CA 94087; 408/738-8400

CIRCLE 333 ON READER SERVICE CARD

**ONE CHIP PLUS**, a design system for Micro Channel-compatible add-in boards, is available from **Capital** 

**Equipment Corporation**. The one CHIP PLUS interface chip supports all features of Micro Channel architecture plus the decoding and logic functions required to simplify memory, I/O, and multifunction adapter boards. The chip includes programmable decoding for extended memory, expanded memory, multiple I/O ports, and ROM. It supports the Micro Channel direct memory access (DMA) arbitration and burstmode DMA, has programmable memory and I/O timing to match slow or fast devices, and can address and connect directly to single or dual in-line memory modules. Interface chip, in 1,000-unit quantities, \$27.50 each.

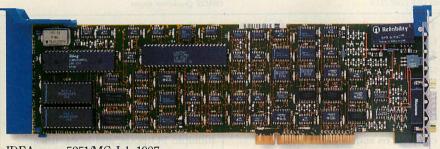
The **ONE CHIP PLUS design kit** includes hardware, software, and documentation. The software includes an extended- and expanded-memory driver that conforms to EMS 4.0 specifications, tools for design optimization, and sample adapter description files that meet IBM's specifications. \$995. Capital Equipment Corporation, 99 S. Bedford Street, Burlington, MA 01803; 800/234-4232; 617/273-1818
CIRCLE 331 ON READER SERVICE CARD

A single-user operating system compatible with DOS 3.3 is now offered to the OEM marketplace from **Digital Research Inc. DR DOS**, designed to provide a low-cost alternative to DOS, includes the ability to reside entirely in ROM, support for hard-disk partitions extended from 32MB to 512MB, and password protection for both files and subdirectories. DR DOS runs DOS applications and supports DOS 3.x file-level and byte-level record locking. Digital Research Inc., P.O. Box DRÍ, Monterey, CA 93942; 408/649-3896

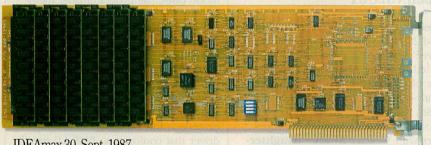
The material that appears in Tech Releases is based on vendor-supplied information. These products have not been reviewed by the PC Tech Journal editorial staff.

SEPTEMBER 1988 51

## Every time IBM giv we're the first



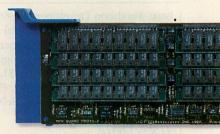
IDEAcomm 5251/MC, July 1987 Local 3X Communications for the IBM PS/2



IDEAmax 30, Sept. 1987 8MB Memory for the PS/2 Model 30



IDEAcomm 5251/ Share/MC, Oct. 1987 PS/2 Gateway Communications to the IBM System 3X



IDEAmax/MC, Oct. 1987 12MB Memory for the IBM PS/2



IDEAcomm 3278/DFT/MC, Nov. 1987 Local Mainframe Communications for the IBM PS/2



IDEA Supermax 30, Nov. 1987 8MB and Ports for the PS/2 Model 30

On April 2, 1987, IBM brought the world to a standstill when it brought the PS/2 to life.

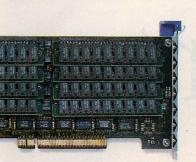
Now while everyone else waited to see how this latest offspring would be accepted, we quietly set out to create products that would help the PS/2 reach its fullest potential. And two months later, we delivered.

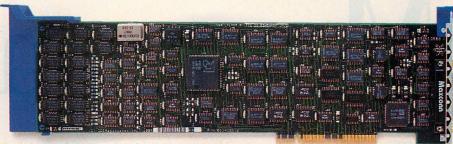
In fact, we were the first to devise completely functional local and remote links between the PS/2 and System 3X minicomputers. First to offer local

and remote gateway communications for the PS/2 on a local area network. And first with a Micro Channel® board that adds up to 12 megabytes of memory.

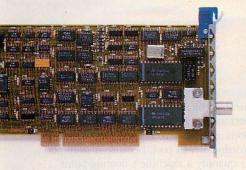
Our list of firsts didn't start with the PS/2, either. For example, we pioneered the industry standard in backplane design for multifunction boards. And we were the first to fully apply surface mount technology, which allowed us to put all the basic computing functions onto one PC board. (Interestingly enough, a year later IBM

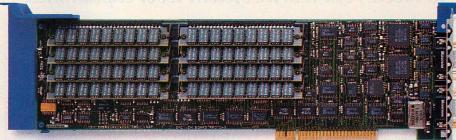
# es birth to a new PC, to send out cards.



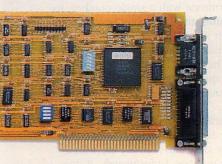


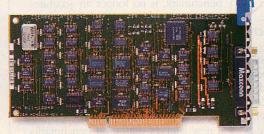
IDEAcomm 3270/SNA/MC, Nov. 1987 Remote Mainframe Communications for the IBM PS/2





IDEA Supermax/MC, Dec. 1987





IDEAcomm 5250/Remote Gateway/MC, Dec. 1987 PS/2 Remote Gateway to the IBM System 3X

IDEAmini/MC, May 1988 I/O Card for the IBM PS/2

used surface mount technology to create the PS/2.)

The ability to conceive products quickly stems from our corporate commitment. Since our inception in 1982, our goal has been to do more than enhance IBM's personal computers. It's been to truly advance them. Our in-house research and development team meets this goal so well, it continually develops PC enhancement products before IBM does.

We're IDEA. And if you want to find out what's really happening with IBM's personal computers, call us at 1-800-257-5027. We'll be the first to tell you.

IDEAssociates
The Leader in PC Technology.

IDEAssociates, Inc., 29 Dunham Road, Billerica, MA 01821, (617) 663-6878, Telex 4979780; France, Hong Kong, Germany, United Kingdom.
The IDEA, IDEAcomm, Supermax and IDEAmax trademarks are registered in the U.S. Patent and Trademark Office by IDEAssociates, Inc. IDEAmini is a trademark of IDEAssociates, Inc. IBM and Micro Channel are registered trademarks of International Business Machines Corporation. PS/2 is a trademark of International Business Machines Corporation.

# High-level Measurements

PC Tech Journal unveils a new suite of benchmarks to assess real-world, system-level capabilities.

KENT QUIRK

Back in the good old days of personal computers—say, 1986—memory was memory, disk drives were disk drives, and PC architecture was simple. Comparing PCs was relatively straightforward—measure the raw, low-level performance of these key hardware components using such guides as memory- and disk-access speed and CPU throughput. Because PCs were similar, these numbers were useful for comparison and provided an estimate of system-level performance.

In the brave new world of 1988, PCs are better, but their architecture is more complex. Systems designers have included a wide range of intermediate-level software and hardware devices that boost performance remarkably. The overall performance of these multilevel systems, however, cannot be equated to the performance of their low-level components.

PC Tech Journal's original compatibility and performance benchmarks, introduced in 1986 and updated in 1987 and 1988, were designed to measure the low-level performance

of the IBM PC/AT and compatible computers. Low-level measurements, however, are much less meaningful these days. Hardware-level memory access speed, for example, once a reliable benchmark, is no longer an accurate way to compare machines equipped with high-speed memory caches. The same can be said of hard-disk access speeds on computers equipped with intelligent disk-drive controllers and disk caches.

To keep pace with this advancing technology, *PC Tech Journal* introduces a new suite of high-level benchmarks, designed specifically to measure performance at the system level. These tests measure critical aspects of system performance as seen by the application and the user rather than the speed of low-level hardware components. The new benchmarks are an accurate gauge of real-world performance, regardless of how systems are configured.

Although this is not a new idea, previous application-level benchmarks were only marginally useful. The well-known, well-worn Whetstone test mea-

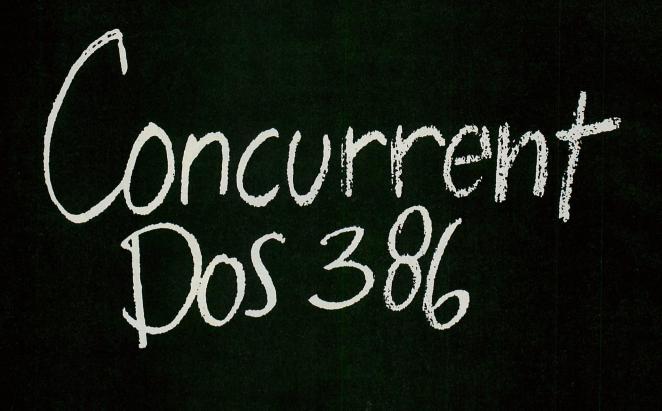
sures application-level performance by performing a "typical" mix of floating-point calculations. It falls short of being worthwhile, in part, because it attempts to quantify a machine's floating-point performance with a single number. Its derivative, the Dhrystone benchmark, though a more general CPU test, is not a realistic application.

These two benchmarks take the same approach with computers that IQ tests take with people—one number is supposed to quantify a broad spectrum of characteristics. The seductive power of the IQ test is ample evidence that people desire to simplify life with a single number. Unfortunately, it does not work. Computers, like people, have different strengths in different areas.

At the very least, all benchmarks measure the ability of the system to perform the benchmark. What distinguishes a good benchmark from a bad one is how well the results can be related to the real world.

PC Tech Journal's new benchmarks address these shortcomings and are designed with three goals in mind.





#### Think small in a big way

When you think multiuser/multitasking, think Concurrent™ DOS 386, the big name in small systems from Digital Research® architects of the first standard operating system for personal computers. Now, Concurrent DOS 386 allows multiple users to share peripherals, files and applications, using serial terminal workstations linked by RS-232 cables to the system. It's fast, reliable and economical.

#### The big news today is small systems

Concurrent DOS 386 meets the increasing demands placed on small systems by supporting multiple DOS programs on both the system console and attached terminals. You can run popular programs such as Lotus® 1-2-3, dBase® III, WordPerfect® and many more, with full math coprocessor support. The system runs up to 255 tasks simultaneously, with full intertask communications and bytelevel record, file and device locking.

#### For people who hate waiting in line

Concurrent DOS 386 brings you all the remarkable speed and power of the Intel® 80386 processor. A prioritized preemptive scheduler allows task execution

and intertask communication by several users at near full processor speed while letting some tasks "interrupt" others according to the needs of each user.

#### A small system with a big memory

Concurrent DOS 386 gives you access to four gigabytes of linear physical memory. Its powerful memory paging capability fully supports the Expanded Memory Specification with no additional hardware or software.

#### Menus at a touch

Now you can create and customize menus, while programmable function keys let you condense complex commands to a single keystroke. The file manager runs standard operating system functions, plus you have an on-line help facility, text editor and support for DOS-based device drivers.

#### Multiuser color graphics

Now with the introduction of the newest member of the Concurrent DOS family, Concurrent DOS 386/Multiuser Graphics Edition, your demands for high-resolution EGA bit-mapped graphics in the workstation environment can

be met. Take advantage of advanced technology allowing you to run popular DOS-based graphics programs on individual workstations as well as on the system console without sacrificing system performance. Ask us about this exciting new version of Concurrent DOS 386.

#### All you have to remember is Concurrent DOS 386

Concurrent DOS 386 from Digital Research is the name to remember when it comes to 386 technology. The power and versatility of Concurrent DOS 386 are giving a new meaning to the word multiuser.

#### **CALL DIGITAL RESEARCH AT** 1-800-443-4200 AND ASK FOR OUR **CONCURRENT DOS PROGRAMMER** INFORMATION KIT.

#### **CONCURRENT DOS 386:** SHARING THE SYSTEM AFFORDABLY

Digital Research and the Digital Research logo are registered trademarks, and Concurrent is a trademark of Digital Research Inc. Other product names are registered trademarks or trademarks ot their respective owners. Specifications are subject to change without notice. Copyright e 1988, Digital Research Inc. All rights reserved.

#### DIGITAL RESEARCH

CIRCLE NO 221 ON READER SERVICE CARD

#### PHOTO 1: HLBENCH Main Menu

Benchmark Main Menu—
Describe this machine
Text Scrolling — DOS/BIOS/C
Text Windows — direct video access
Graphics Video — lines, fills, graphs
CPU Speed — Sort test
Floating Point — FFT
Disk Speed — Database test
Run all above tests
Display and compare results
Return to DOS

HLBENCH is used to describe the system being tested, run the six benchmark test programs, and display and compare benchmark results using the HLANALYZ program.

#### PHOTO 2: HLANALYZ Main Menu

Compare XREF and CURRENT
Select reference machine
Display data for reference machine
Select another machine
Display data for other machine
Text comparison of both machines
Graphical comparison of major features
Printed comparison in detail
Return to main menu

HLANALYZ displays and compares the benchmark results of two machines, including the tested machine and the default reference machine (the IBM PC/AT Model 339).

First, they test at the system level, performing operations that real-world applications perform. Second, each test is of sufficient duration to evaluate the new systems that run at 25 MHz and faster. Third, they are written in a high-level language (Microsoft C 5.1) so that they can be ported to other environments (particularly OS/2).

Like PC Tech Journal's original performance metrics, the new benchmarks form a coherent suite designed to measure a wide range of system performance. Rather than a single test with a single result, the benchmarks are a series of more than two dozen tests grouped into six modules. Each module measures how well a system runs primary elements of an application. One module simulates disk-intensive applications by performing operations such as database creation, indexing, and report generation. Similarly, others gauge video, CPU, memory, and floating-point arithmetic performance.

Each benchmark module operates by itself or under the control of the HLBENCH menu-driver program. From the HLBENCH main menu (see photo 1), the evaluator can enter a description of the computer being tested, run each module separately or run the entire suite, and choose options for displaying the benchmark results by selecting "Display and compare results." The latter option displays the main menu for the analysis program, HLANALYZ (see photo 2). From this menu, the evaluator can compare the computer being tested to a selected reference computer or can compare benchmark data for any two machines in the benchmark library. Results can be presented in tables or bar charts.

The source and executable code for *PC Tech Journal*'s high-level benchmarks and the test results from this article are available on PCTECHline (301/740-8383). Note that to produce test results compatible with those given in the article, the programs must be compiled and linked using the Microsoft C 5.1 compiler.

#### THE TESTS IN DETAIL

A separate program tests each major area of system performance. HLTEXT examines text scrolling; HLWINDOW deals with windowing and scrolling; HLGRAPH performs 16-color graphics tests; HLSORT tests the CPU and memory; HLFLOAT measures computational speed; and finally, HLDISK performs disk operations.

HITEXT executes the same set of tests in four different modes. Each test scrolls 200 copies of a short, a medium-length, and a long string to check text-mode speed in DOS, BIOS, and using Microsoft C 5.1's text-handling routines (the \_outtext function) in small and full-screen windows.

To test a combination of direct video-memory access and scrolling, HLWINDOW opens windows, scrolls text through them using the \_outtext function, and closes them. Only the total time for the test is reported.

HLGRAPH uses the traditional approach for measuring graphics performance—drawing random-size areas, lines, and ellipses. Each is drawn in a small and large area. Because the pixel count for the small and large areas is similar, function-call overhead can be compared to function execution time. The final HLGRAPH test draws typical line, bar, and pie charts.

The HLSORT module tests CPU speed by generating an array of 30,000 random integers and sorting them using the Quicksort algorithm supplied with the Microsoft C compiler. Originally written with an option to reverse the sort (which is still implemented in the stand-alone mode), this implementation uncovered an interesting failure in Microsoft's qsort function.

When asked to reverse an alreadysorted list, **qsort** delivers worst-case performance—and the worst case is very bad. For a 2,000-point array, the reverse time is 50 times the original sort time, and the differential increases as the square of the number of points.

The floating-point benchmark, HLFLOAT, comes the closest of any of the benchmark modules to being an actual application. HLFLOAT performs a Fast Fourier Transform (FFT) on data it generates internally. By way of background, a Discrete Fourier Transform (DFT) takes a set of data points (usually sampled from a signal at equal intervals) and by a series of mathematical operations, generates the signal's frequency spectrum. Analysis of a signal's frequency components has application in fields ranging from studies of brain waves to voice recognition.

Unfortunately, DFT requires an enormous number of mathematical operations. An FFT is a faster algorithm for performing the same task, although still computationally intensive.

The HLFLOAT benchmark generates and graphs a set of data. An FFT processes the data and the result is graphed. The frequency spectrum is then "low-pass" filtered; all frequency components above the eleventh harmonic are deleted (set to zero). Finally,



### Introducing REMOTE<sup>2</sup> It's never been so easy to do so much in distant PC operation.

Until now, to have this kind of flexibility and control over a host PC, you'd have to be in the same room.

Now, even if you're thousands of miles away, REMOTE<sup>2</sup> allows you to operate a host PC's application software with total control and exact mapping of the host keyboard...fast file transfers even while an application program is running ...remote printer redirection...an error-checked, datacompressed link even with conventional modems...and CGA color graphics.

REMOTE<sup>2</sup> comes in two parts—R2HOST and R2CALL—available together or separately, so you can create the combination to meet your exact needs. R2HOST is also accessible from most terminals and terminal emulators.

REMOTE<sup>2</sup> is packed with features users have asked for. A choice of three distinct automatic and manual answering modes. Directory-to-directory file transfers using a half-screen display of host files. Proprietary file transfer protocol with redundant file skipping and partial file recovery (other popular protocols also supported). A "Phone Book" that facilitates one-entry calls from listings of names, numbers, and passwords. Host call-back capability. Integrated, context-sensitive help system. LAN access. Mainframe access to an IBM host with IRMA. And more.

Discover the new remote control program from the makers of CROSSTALK. Ask your dealer about REMOTE<sup>2</sup>, or write us.

REMOTE<sup>2</sup>

CROSSTALK COMMUNICATIONS/1000 Holcomb Woods Parkway, Roswell, Georgia 30076/(800) 241-6393

A Division of Digital Communications Associates, Inc.

CROSSTALK is a registered trademark of Digital Communications Associates, Inc./CASL, IRMA and Smart Alec are trademarks of Digital Communications Associates, Inc./CompuServe is a registered trademark of CompuServe, Inc., an H&R Block Company

#### HIGH-LEVEL MEASUREMENTS

HLFLOAT reconstructs the time-domain signal by running a reverse FFT. The result, a low-pass filtered version of the original signal, is replotted over the original as a comparison.

HLDISK tests disk performance by generating a fixed-format database containing a set of randomly generated fictional data in a format that might be used by a sales department (names, addresses, purchase amounts). The module then builds an index file consisting of the zip code and name fields from the database and sorts the index file using a disk-based sort, which has the advantage of requiring very little RAM. RAM requirements remain static regardless of database size. The algorithm used is the Shell sort.

Next, HLDISK reads the file in index order and generates a summary report of the total sales by state. Because the records are generated randomly, the benchmark reads the database in random order.

To recreate the file using a sequential read, the benchmark reads and rewrites the file in the same order as the index (a database reorganization). A comparison of the two report times highlights the differences between random and sequential reads and suggests how reorganizing a database can improve performance. It can sometimes be a significant difference, particularly if a disk has a high transfer speed and only an average or slow random-seek time.

#### **COMMAND AND CONTROL**

HLBENCH controls the execution of the test programs, the HLDESC description program, and the HLANALYZ data analysis program. HLBENCH passes information to the test programs using the following switches: -B, -P, -F, -A, and -?. The -B option tells the module to run in the BENCH mode and store its results in the benchmark data file (display of results on the screen is suppressed); -P, followed by a number, indicates which page of slots the test program should use; and -F displays the data file name (a .TIM extension is always implied). The -A mode tells the benchmark that it is part of a "run all tests" sequence and should not pause for keystrokes as it would in standalone mode.

Each test program also has switches that can be used to configure the test for a user's specific needs when run in stand-alone mode. The -? option causes the benchmark to print a summary of its usage and options to standard output.

The benchmark data file (with the default name CURRENT.TIM) consists of several pages, each containing eight slots. Each benchmark stores data on a page on the command line. A benchmark slot comprises a 60-character string and a 4-byte number of timer ticks. The contents of the text field are free-form, but the zero slot in each page must contain the total number of time ticks for that benchmark. HLBENCH converts individual and total test results from 18.2-Hz timer ticks to seconds for display. For this reason, the total displayed is not always the exact sum of the individual results displayed.

The HLDESC program stores the description of each machine to aid in identification and interpretation of the

Each of the benchmark modules operates independently or under the control of the HLBENCH menudriver program.

benchmark results. The description file, which the evaluator can edit in page zero of the benchmark record, can be up to eight 55-character lines for information such as model number, memory installed, and hard-disk capacity.

HIANALYZ compares results from two benchmark data files. If the evaluator asks to see the data in tables, the HIANALYZ module displays the totals for each of the six modules inside a bounce-bar menu. Selecting one of the menu options (such as disk performance) displays the results of the six tests used to simulate disk-intensive applications. For graphic comparisons, the program displays the totals for each of the six tests in a bar chart.

#### **SOME REAL DATA**

Benchmarks are meaningless if not put into context; the benchmarks for a machine are useful only when compared with benchmarks for other systems. To provide that reference, the *PC Tech Journal* benchmarks were run on a variety of systems. For comparison with the class of machines using the 80286 series of processors, the IBM PC/AT Model 339, the IBM PS/2 Models 50 and 60, and the Compaq Deskpro 286 and Portable III systems were tested (see table 1 and figure 1).

The CPU/Sort benchmark has the most obvious results; they correlate perfectly with the clock rates of the various machines. The PS/2 machines run at 10 MHz, 25-percent faster than the AT. The Deskpro and Portable III, which show a 50-percent performance improvement over the AT, run at 12 MHz. This is to be expected because all these machines have the same type of CPU and memory architecture.

Similar results are evident with HLFLOAT. The numbers, however, do not correlate exactly to the floating-point clock rates because the results depend on the speed of the 286 as well as the 287. Even though the 287 in Models 50 and 60 runs 87-percent faster than the AT's (10 MHz versus 5.33 MHz), the 286 runs only 25-percent faster (10 MHz versus 8 MHz) resulting in a net speed improvement of 66 percent as measured by HLFLOAT.

The AT clearly loses out in video performance. Although the PS/2's CPU is only 25-percent faster, text scrolling is more than twice as fast. Two features of the PS/2 account for this performance. First, the PS/2's Video Graphics Array (VGA) dual-ported video RAM (VRAM) display memory can be accessed much faster than the EGA's display memory. Second, the PS/2 has faster BIOS code. The windowed scrolling and Microsoft C scrolling tests do the same thing, except that the windowed test scrolls much smaller portions of the screen. This implies that a greater percentage of the test is taken up by BIOS overhead. The PS/2 is twice as fast as the AT in the Microsoft C scrolling test and the windowed scrolling test. The BIOS code can take much of the credit for the increase in

Comparing the graphics capabilities of these machines is difficult. The AT uses an EGA (640-by-350 pixels, 16 colors), PS/2 computers are equipped with a VGA on the system board (640 by 480 pixels, 16 colors), and the Compaq machines use a plasma display that emulates a CGA (320-by-200 pixels, 4 colors). Because the graphics test normally uses the highest resolution video mode available, these timings are not truly comparable. Nonetheless, the AT with its EGA loses out again, taking longer although its resolution is lower than that of the VGA.

Although they offer better video performance than the AT, the PS/2s are lacking in some areas. One of the biggest complaints from users about the Model 50 has been its slow hard-disk drive. It is by far the slowest of the five

SEPTEMBER 1988 59

 TABLE 1: Benchmark Results for 80286-based Computers

| con reprise the back mediums one machines. The back modulues at 10 MHz, 25 percent faster than | IBM PC/AT<br>MODEL<br>339 | IBM PS/2<br>MODEL 50 | IBM PS/2<br>MODEL 60 | COMPAQ<br>DESKPRO<br>286 | COMPAQ<br>PORTABLE III |
|--|---------------------------|----------------------|----------------------|--------------------------|------------------------|
| EQUIPMENT  | 100 Land                  |                      | But anite 1 19       | y sin hash teaten        | Soft a primary         |
| ROM BIOS date  | 11/15/85                  | 02/13/87             | 02/13/87             | 05/15/87                 | 01/29/87               |
| Processor speed (MHz)  | 8                         | 10                   | 10                   | 12                       | 12                     |
| Coprocessor speed (MHz)  | 5.33                      | 10                   | 10                   | 8                        | 8                      |
| Base memory size   | 512KB                     | 1MB                  | 1MB                  | 640KB                    | 640KB                  |
| Video controller   | 8-bit EGA                 | 8-bit VGA            | 8-bit VGA            | 8-bit EGA                | 8-bit Plasma           |
| Hard-disk size (MB)  | 30                        | 20                   | 44                   | 40                       | 40                     |
| HLTEXT (text scrolling)  |                           |                      |                      |                          |                        |
| BIOS   | 26.37                     | 12.08                | 12.08                | 10.60                    | 11.59                  |
| DOS  | 29.67                     | 14.67                | 14.67                | 12.85                    | 13.84                  |
| C library  | 23.46                     | 12.52                | 12.52                | 9.56                     | 9.94                   |
| Windowed   | 12.08                     | 5.21                 | 5.21                 | 4.23                     | 4.28                   |
| Total  | 91.59                     | 44.50                | 44.50                | 37.25                    | 39.67                  |
| HLWINDOW (window/scrolling)  | mov Living to the         |                      |                      | NUMBER OF STREET         | S principal sala       |
| Total  | 17.52                     | 8.24                 | 8.24                 | 6.42                     | 6.59                   |
| <b>HLGRAPH</b> (16-color graphics) <sup>a</sup>  | 17.92                     | 0.21                 | 0.2.                 |                          | 0.57                   |
| 400 Small areas  | 5.98                      | 6.04                 | 5.98                 | 3.73                     | 1.48                   |
| 100 Large areas  | 3.73                      | 4.23                 | 4.23                 | 2.14                     | 0.93                   |
| 400 Small ellipses   | 9.83                      | 8.46                 | 8.40                 | 6.53                     | 3.79                   |
| 200 Large ellipses   | 9.50                      | 7.91                 | 7.91                 | 6.31                     | 3.62                   |
| 4,000 Short lines  | 6.53                      | 5.87                 | 5.87                 | 4.28                     | 3.29                   |
| 2,000 Long lines   | 5.76                      | 5.38                 | 5.32                 | 3.79                     | 2.74                   |
| General graphs   | 1.37                      | 1.31                 | 1.31                 | 0.87                     | 0.38                   |
| Total  | 42.74                     | 39.23                | 39.06                | 27.69                    | 16.26                  |
|  | 12./1                     | 39.43                | 39.00                | 27.09                    | 10.20                  |
| HLSORT (CPU/memory)  | 2.00                      | 1.//                 | Amenda de            | porter matter to the     | Svorgen no exc         |
| Data generation  | 2.08                      | 1.64                 | 1.64                 | 1.37                     | 1.37                   |
| Memory sort  | 23.02                     | 18.46                | 18.46                | 15.38                    | 15.38                  |
| Total  | 25.10                     | 20.10                | 20.10                | 16.75                    | 16.75                  |
| HLFLOAT (Fast Fourier Transform)   |                           |                      |                      |                          |                        |
| Forward  | 18.13                     | 10.87                | 10.87                | 13.02                    | 13.02                  |
| Reverse  | 17.58                     | 10.60                | 10.60                | 12.58                    | 12.63                  |
| Total  | 35.71                     | 21.48                | 21.48                | 25.60                    | 25.65                  |
| <b>HLDISK</b> (with disk cache) <sup>b</sup>   |                           |                      |                      |                          |                        |
| Data file creation   | 1.59                      | 4.17                 | 3.13                 | 3.35                     | 3.24                   |
| Index file creation  | 34.72                     | 36.20                | 32.19                | 28.24                    | 28.24                  |
| First report generation  | 3.62                      | 2.91                 | 2.58                 | 2.41                     | 2.47                   |
| Data reorganization  | 5.05                      | 7.08                 | 5.98                 | 5.16                     | 5.00                   |
| Second report generation   | 1.20                      | 2.19                 | 1.86                 | 1.53                     | 1.42                   |
| Total  | 46.37                     | 52.69                | 45.87                | 40.93                    | 40.43                  |
| HLDISK (without disk cache)  |                           |                      |                      |                          | rollal II- (Decem      |
| Data file creation   | 3.40                      | 4.06                 | 3.13                 | 3.40                     | 3.24                   |
| Index file creation  | 44.67                     | 46.42                | 43.62                | 34.39                    | 34.39                  |
| First report generation  | 11.70                     | 16.92                | 11.20                | 11.20                    | 10.87                  |
| Data reorganization  | 16.64                     | 28.35                | 15.93                | 16.64                    | 15.98                  |
| Second report generation   | 3.35                      | 3.95                 | 3.24                 | 3.46                     | 3.24                   |
| Total  | 79.94                     | 99.83                | 77.19                | 69.34                    | 67.85                  |
| All times are in seconds   |                           |                      |                      | THE PROPERTY OF          |                        |

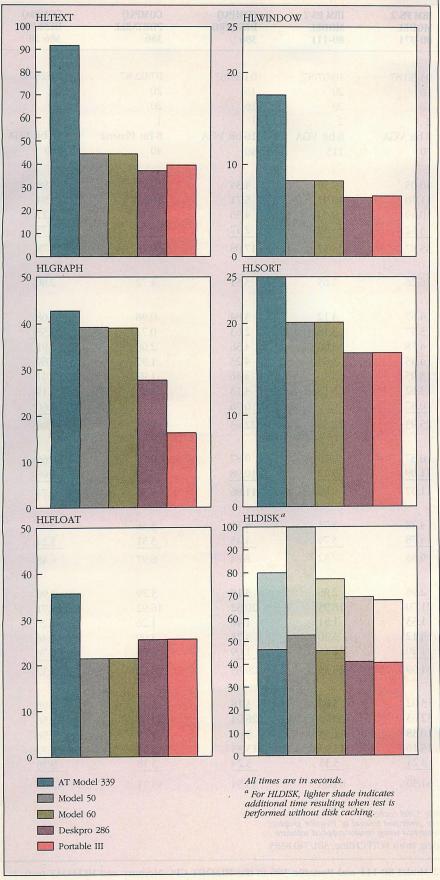
All times are in seconds.

The CPU/Sort results correlate with the CPU speeds of the machines. The PS/2 Models 50 and 60 run at 10 MHz, 25-percent faster than the AT. The Compaq machines, which show a 50-percent performance improvement over the AT, run at 12 MHz. HLFLOAT results show a less pronounced performance difference because the 287 on the Compaq machines runs at 8 MHz.

<sup>&</sup>lt;sup>a</sup> For the Compaq Portable III, 4-color graphics were generated instead of 16-color graphics.
<sup>b</sup> The 256KB extended-memory disk cache was implemented using Multisoft's Super PC-Kwik disk cache on the IBM PC/AT; vendor-supplied disk cache software was used with the other machines.

Benchmark results are available for downloading from PCTECHline, 301/740-8383.





The IBM PS/2 Models 50 and 60 and the Compaq Deskpro 286 and Portable III outperform the IBM PC/AT Model 339 in all areas except disk operations.

machines when disk-caching software is not used. In a demonstration of the usefulness of system-level tests, however, HLDISK shows that with disk-caching, all five of the computers exhibit approximately the same performance in this area.

Table 2 and figure 2 present results for several 16- and 20-MHz 386-based machines. The results for the Model 80-111 and the Deskpro 386/20 show that systems with the same processors and clock rate do not necessarily have the same performance.

The video numbers are the most startling results. The Deskpro 386/20 performs the text- and windowedscrolling tests over twice as fast as the IBM Model 80. An examination of the hardware reveals that Compag's VGA has a 16-bit interface, while the VGA built into the Model 80 has an 8-bit interface. Therefore, the Model 80 requires twice as many bus cycles to transfer the same amount of data. Compag's video BIOS accommodates the 16-bit interface and achieves a remarkable gain in text performance. The 25percent graphics speed improvement is not as striking, because the graphics routines in Microsoft C are not written to take advantage of 16-bit I/O.

The CPU and floating-point test differentials are 27 and 16 percent, respectively, because the Compaq memory interface is better than the Model 80's. Compaq uses a 32KB high-speed SRAM cache with its DRAM memory, whereas the Model 80-111 uses a page-mode memory architecture similar to that used on the Compaq Portable 386.

The Deskpro 386/20 accesses information stored in the 35-ns cache memory with zero wait states inserted (100-ns). The Model 80-071's page-mode memory architecture provides zerowait-state (100-ns) access to locations within the same 2KB page, but requires two wait states (400-ns) to access data not within the same 2KB memory page.

In the disk test, the two machines created a sequential file in the same amount of time. With no disk-caching software installed and the number of DOS buffers set to 25, creation of the index file (the disk-based Shell Sort), the first report generation, and the disk reorganization took much longer on the IBM than on the Compaq. The Deskpro 386/20 is faster at random seeks than the Model 80-111. Thus, an application consisting primarily of sequential accesses should run well on either machine, but the Compaq Deskpro 386/20 clearly prevails on random access databases.

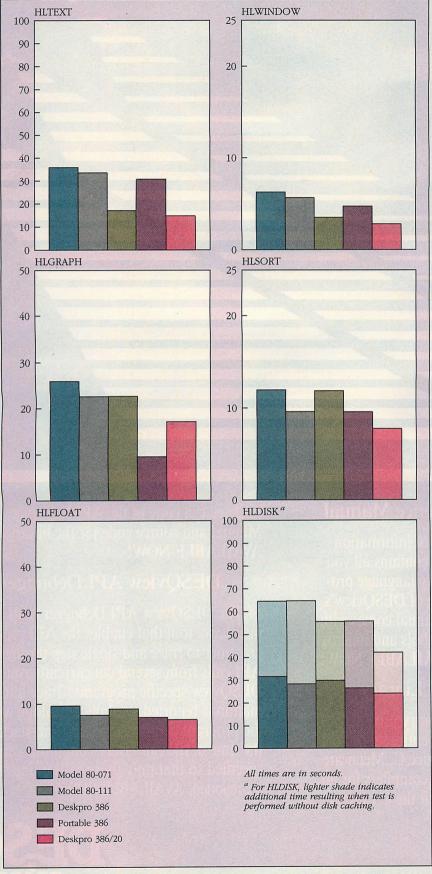
**TABLE 2:** Benchmark Results for 80386-based Computers

| or ill Disk show therwith disk<br>ching all the or the companers ex-   | IBM PS/2<br>MODEL<br>80-071 | IBM PS/2<br>MODEL<br>80-111 | COMPAQ<br>DESKPRO<br>386 | COMPAQ<br>PORTABLE<br>386 | COMPAQ<br>DESKPRO<br>386/20 |
|--|-----------------------------|-----------------------------|--------------------------|---------------------------|-----------------------------|
| EQUIPMENT  |                             |                             |                          |                           |                             |
| ROM BIOS date  | 03/30/87                    | 10/07/87                    | 04/27/87                 | 07/02/87                  | 01/28/88                    |
| Processor speed (MHz)  | 16                          | 20                          | 16                       | 20                        | 20                          |
| Coprocessor speed (MHz)  | 16                          | 20                          | 16                       | 20                        | 20                          |
| Base memory size (MB)  | 2                           | 2                           | 1                        | 1                         | 1 <sup>a</sup>              |
| Video controller   | 8-bit VGA                   | 8-bit VGA                   | 16-bit VGA               | 8-bit Plasma              | 16-bit VGA                  |
| Hard-disk size (MB)  | 70                          | 115                         | 40                       | 40                        | 300                         |
| HLTEXT (text scrolling)  |                             |                             |                          |                           |                             |
| BIOS   | 10.05                       | 9.50                        | 4.34                     | 9.28                      | 3.95                        |
| DOS  | 11.70                       | 10.93                       | 5.71                     | 10.54                     | 4.94                        |
| C library  | 10.49                       | 9.94                        | 4.56                     | 8.18                      | 4.12                        |
| Windowed   | 3.62                        | 3.18                        | 2.47                     | 2.74                      | 1.75                        |
| Total  | 35.87                       | 33.57                       | 17.08                    | 30.76                     | 14.78                       |
|  | 33.07                       | 55.71                       | 17.00                    | 30.70                     | 14.70                       |
| HLWINDOW (window/scrolling)  | 626                         | 565                         | 251                      | 6.70                      | 2.00                        |
| Total  | 6.26                        | 5.65                        | 3.51                     | 4.72                      | 2.80                        |
| <b>HLGRAPH</b> (16-color graphics) <sup>b</sup>  |                             |                             |                          |                           |                             |
| 400 Small areas  | 4.67                        | 4.12                        | 3.84                     | 0.98                      | 3.68                        |
| 100 Large areas  |                             | 3.18                        | 2.63                     | 0.71                      | 2.58                        |
| 400 Small ellipses   | 4.78                        | 4.06                        | 4.56                     | 2.08                      | 2.91                        |
| 200 Large ellipses   | 4.45                        | 3.84                        | 4.23                     | 1.97                      | 2.69                        |
| 4,000 Short lines  | 3.95                        | 3.40                        | 3.46                     | 1.92                      | 2.41                        |
| 2,000 Long lines   | 3.62                        | 3.18                        | 3.13                     | 1.64                      | 2.19                        |
| General graphs   | 0.87                        | 0.76                        | 0.76                     | 0.16                      | 0.60                        |
| Total  | 25.93                       | 22.58                       | 22.63                    | 9.50                      | 17.08                       |
| HLSORT (CPU/memory)  |                             |                             |                          |                           |                             |
| Data generation  | 0.87                        | 0.76                        | 0.87                     | 0.76                      | 0.65                        |
| Memory sort  | 11.09                       | 9.12                        | 10.98                    | 8.79                      | 7.08                        |
| Total  | 11.97                       | 9.89                        | 11.86                    |                           | Charles of the second       |
| Section of the Section of the Colonia Section of the Section of th | 11.97                       | 9.09                        | 11.80                    | 9.56                      | 7.74                        |
| HLFLOAT (Fast Fourier Transform)   |                             |                             |                          |                           |                             |
| Forward  | 4.78                        | 3.73                        | 4.39                     | 3.46                      | 3.24                        |
| Reverse  | 4.78                        | 3.79                        | 4.45                     | 3.51                      | 3.24                        |
| Total  | 9.56                        | 7.52                        | 8.84                     | 6.97                      | 6.48                        |
| <b>HLDISK</b> (with disk cache) <sup>c</sup>   |                             |                             |                          |                           |                             |
| Data file creation   | 2.96                        | 2.96                        | 3.18                     | 3.29                      | 2.96                        |
| Index file creation  | 21.70                       | 18.95                       | 20.32                    | 16.92                     | 15.71                       |
| First report generation  | 1.53                        | 1.31                        | 1.48                     | 1.26                      | 1.26                        |
| Data reorganization  | 4.12                        | 3.90                        | 3.73                     | 3.90                      | 3.46                        |
| Second report generation   | 1.20                        | 1.15                        | 1.09                     | 1.04                      | 0.76                        |
| Total  | 31.59                       | 28.35                       | 29.83                    | 26.48                     | 24.12                       |
|  |                             | 20.55                       | 47.03                    | 20.40                     | 44.12                       |
| HLDISK (without disk cache)  | 2.02                        | 2.02                        | 2.10                     |                           |                             |
| Data file creation   | 3.02                        | 3.02                        | 3.18                     | 3.29                      | 2.96                        |
| Index file creation  | 32.63                       | 30.76                       | 26.04                    | 24.01                     | 22.58                       |
| First report generation  | 10.38                       | 11.53                       | 9.67                     | 9.89                      | 5.98                        |
| Data reorganization  | 15.16                       | 15.93                       | 13.35                    | 15.27                     | 9.72                        |
| Second report generation   | 3.24                        | 3.35                        | 3.24                     | 3.18                      | 0.76                        |
| Total  | 64.50                       | 64.67                       | 55.54                    | 55.71                     | 42.08                       |
| All times are in seconds.  |                             |                             |                          |                           |                             |

The Deskpro 386/20 outperforms the PS/2 Model 80-111 and Portable 386 in the HLSORT CPU/Memory and HLFLOAT tests. The Portable 386 has the shortest time for the HLGRAPH test because it generates only four-color graphics. All the machines provide nearly the same disk performance when using a disk cache even though they perform quite differently without it.

 <sup>&</sup>lt;sup>a</sup> The Compaq Deskpro 386/20 comes equipped with a 32KB cache.
 <sup>b</sup> For the Compaq Portable 386, 4-color graphics were generated instead of 16-color graphics.
 <sup>c</sup> The 256KB extended-memory disk cache was implemented using vendor-supplied software. Benchmark results are available for downloading from PCTECHline, 301/740-8383.

FIGURE 2: 80386 Computer Performance Comparison



Comparing the HITEXT test results shows that components such as the Compaq Deskpro 386/20's 16-bit VGA interface significantly affect performance.

The disk test underscores the benefits of good disk management. Because moving the disk head around takes time, performance is increased by sorting the database to convert a random-access procedure (such as report generation) to a sequential access (which minimizes head motion). If the report is created often, it is worthwhile to take the time to reorganize the disk.

File fragmentation is another headache when running large database applications. A database program may use several files, each of which can grow in size independent of the others. A disk organizer program, such as Golden Bow's Vopt, reorganizes disk files to reduce fragmentation, often significantly increasing performance. The HLDISK measurements shown in table 2 were taken after the hard disk was formatted to eliminate fragmentation.

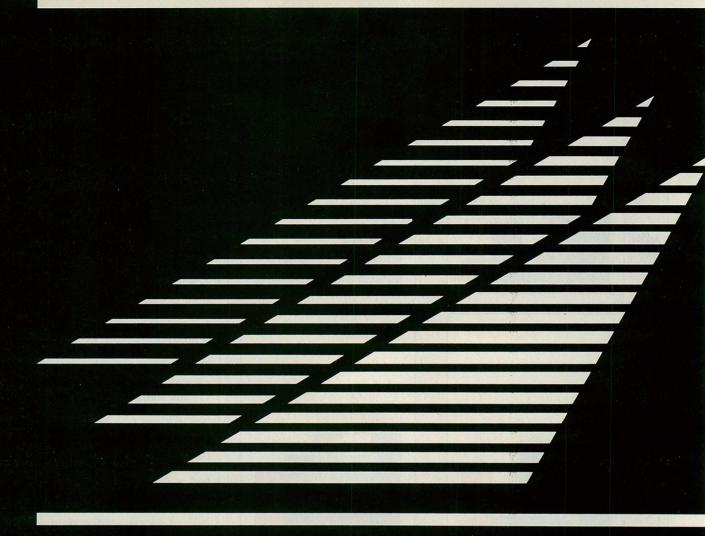
Disk-caching software improves performance, as seen by the application, and can level out differences in hardware performance. Disk-caching software is supplied with the Model 80-111 and with the Deskpro 386/20. Disk-caching saves the most recently read disk data in a large RAM buffer so that when needed again, the data can be retrieved without reading the disk, which is much more time-consuming. With a 256KB extended-memory disk cache installed, both systems run HLDISK nearly twice as fast and exhibit close to the same disk performance.

#### READY FOR TAKEOFF

Benchmarks can be used to compare the performance of existing systems, but most people prefer to use them to assess the capabilities of new machines and subsystems.

The benchmark results published in this article are available on PCTECHline along with the benchmark programs. As new systems are reviewed, PC Tech Journal will provide the benchmark results on PCTECHline as well as in the review. This will let you benchmark systems and compare them with systems in the benchmark library. The first such article is the review of four 25-MHz 386 systems in this issue (see "100 MHz of Performance," David Claiborne and Jim Shields, this issue, p. 66). Do not be too disappointed if your machine appears slow compared with these speed demons. 

Kent Quirk is president of Totel Systems Inc., a Westford, Massachusetts, firm specializing in custom and semi-custom hardware and software development as well as the manufacture of commercial electronic systems.



#### **DESQview API Reference Manual**

This is the primary source of information about the DESQview API. It contains all you need to know to write assembly language programs that take full advantage of DESQview's capabilities. The Reference manual comes with an include file containing symbols and macros to aid you in development. AVAILABLE NOW!

#### **DESQview API C Library**

The DESQview API C Library provides C Language interfaces for the entire set of API functions. It supports the Lattice C, Metaware C, Microsoft C, and Turbo C compilers for all memory models. Included with the C Library

package is a copy of the API Reference Manual and source code for the library. AVAILABLE NOW!

#### **DESQview API Debugger**

The DESQview API Debugger is an interactive tool that enables the API programmer to trace and single step through API calls from several concurrently running DESQview-specific programs. Trace information is reported symbolically along with the program counter, registers, and stack at the time of the call. Trace conditions can be specified so that only those calls of interest are reported. AVAILABLE NOW.



# Introducing DESQview 2.0 API Tools

### Bringing new power to DOS

#### **DESQview API Panel Designer**

The DESQview API Panel Designer is an interactive tool to aid you in designing windows, menus, help screens, error messages, and forms. It includes an editor that lets you construct an image of your panel using simple commands to enter, edit, copy, and move text as well as draw lines and boxes. You can then define the characteristics of the window that will contain the panel, such as its position, size, and title. Finally, you can specify the locations and types of fields in the panel.

The Panel Designer automatically generates all the DESQview API data streams necessary

to display and take input from your panel. These data streams may be grouped together into panel libraries and stored on disk or as part of your program. AVAILABLE NOW.

#### DESQview API Pulldown Menu Manager

The DESQview API Pulldown Menu Manager is an interactive tool to aid you in designing pulldown menus. This DESQview API tool assists you in giving your DOS program an OS/2-like look and feel. AVAILABLE OCTOBER 88.

MS-DOS and IBM PC-DOS are both trademarks of Microsoft Corporation and IBM Corporation respectively.

Quarterdeck Office Systems 150 Pico Boulevard Santa Monica, CA 90405 (213) 392-9851

# 100 MHz of Performance

Four 25-MHz computers—from ALR, Compaq, Everex, and IBM—bit the market in rapid succession this summer. Although they use the same 386 processor, not all 25-MHz machines are created equal.

DAVID CLAIBORNE and JIM SHIELDS

A market will always exist for the "ultimate" desktop computer. Aside from the damn-the-cost, full-speedahead crowd, there will always be tasks demanding enough to require the highest performance desktop computer available. ALR, Compaq, Everex, and IBM are among the first to introduce the "latest" ultimate computer—the 25-MHz machine.

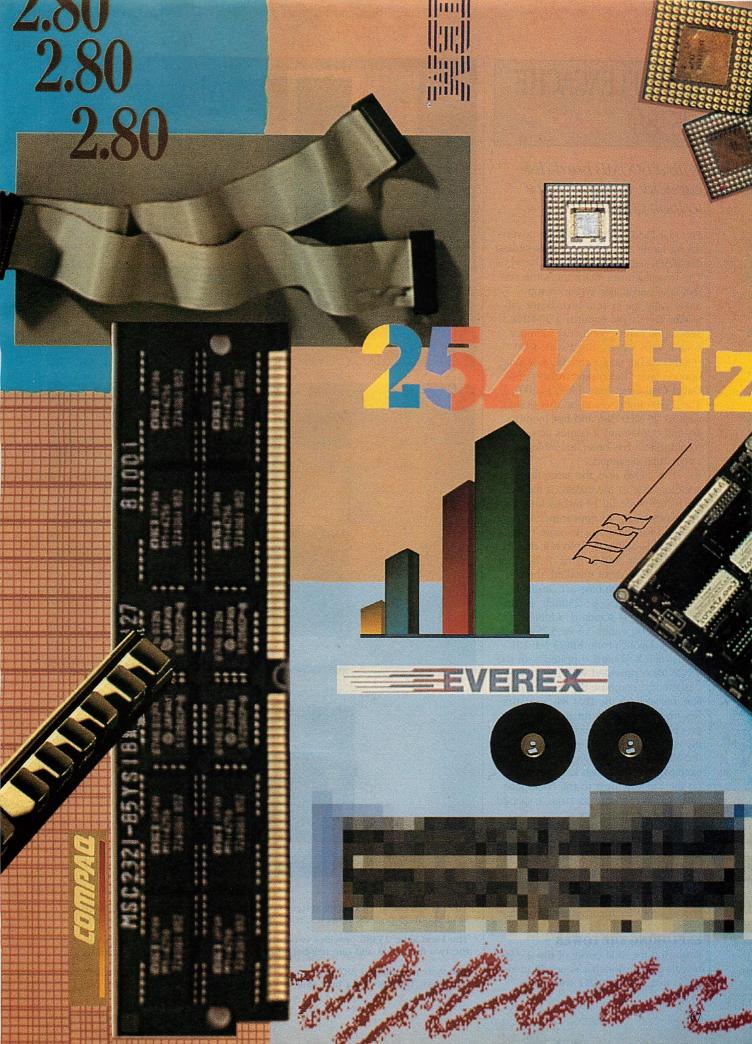
ALR and Everex announced 25-MHz AT-bus compatibles on the second day of May. A month later, IBM unveiled the Model 70 series, which includes a 25-MHz machine at the high-end. Compaq joined the rest of the field in late June with the Deskpro 386/25.

All four computers combine the 25-MHz Intel 80386 microprocessor with innovative methods in memory access and caching, disk-drive accessing, and video processing. Each manufacturer, however, has added a little twist to meet the needs of a different group of users. The four

machines also differ markedly in quality. In the mad dash to get across the 25-MHz starting line, some manufacturers were willing to take a few short cuts.

The systems range in character from the upwardly mobile IBM PS/2 Model 70, which provides high performance in a small desktop package, to the hulking ALR 25386, which is best employed as a LAN or multiuser-system server in an area mostly hidden from view.

Though they offer roughly the same performance, the machines vary considerably in cost—from about \$9,500 for the ALR to about \$11,500 for a comparably equipped Compaq. Surprisingly, the IBM machine is *not* the most expensive. Each machine is checked for compatibility and subjected to performance tests using *PC Tech Journal*'s new benchmarks, developed in part to measure the potential of this new class of machine (see "High-level Measurements," Kent Quirk, this issue, p. 54).



## ALR FLEXCACHE 25386

### With a 600MB hard-disk capacity, it doesn't have to look good.

The ALR FlexCache 25386 bears a very strong family resemblance to its sibling, the 20386-it is tall, dark, and heavy. The two machines share the same system case and major system components; only the system boards are different. The 20386 features a 20-MHz 386, an 80-nanosecond (ns) memory system with a high-speed static-RAM (SRAM) cache, and a variety of storage options (see "Industrial-Strength 386," David Claiborne, June 1988, p. 100). The 25386 improves upon this design, with its 25-MHz 386 and fast memory system, but overall it comes across as a machine that has been assembled rather than designed.

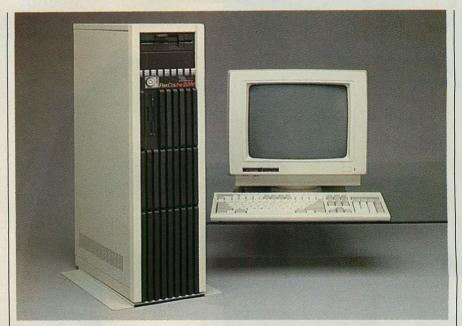
The 25386 uses the same floor-standing case as the 20386 (it measures 7.5 inches wide by 17 inches long by 26 inches high). Its appearance is austere, but for many this is more than offset by its ability to hold not one, but two 150MB or 300MB hard disks. Even with two hard disks installed, three half-height storage bays are available for diskette drives. A 5.25-inch 1.2MB diskette drive is standard; additional drives can be either 3.5 or 5.25 inches.

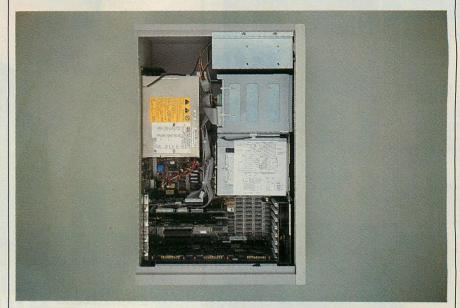
The layout of the EECO ME-101 Maxiswitch keyboard supplied with the 25386 (also provided with the 20386) is designed to combine the most popular features of both the IBM 84- and 101-key keyboards. Unfortunately, in the process, it creates a keyboard that will not satisfy users of either model. On the Maxiswitch's 101-key layout, for example, the backslash key is located on the top row next to the backspace key to accommodate its large, L-shaped (84-key style) Enter key.

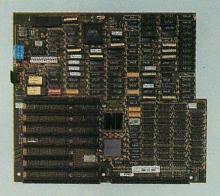
The Maxiswitch is a trial for users familiar with a standard 101-key keyboard, and 84-key aficionados will not be fond of the function keys placed along the top. The cable cannot be detached from the Maxiswitch keyboard—another inconvenient feature.

#### **EXPLORING THE TOWER**

Removing the side cover of the 25386 reveals an interior that is nearly identical to that of the 20386, with a few







The floor-standing FlexCache system unit provides room for expansion. Weighing in at about 75 pounds, however, it requires a lot of muscle to move around.

The FlexCache 25386 provides two half-height, 5.25-inch drive bays in addition to the two full-height and one half-height drive bays in the inner AT-size chassis.

The system's 386 and 387 math coprocessor are mounted in front of the expansion slots. The 386 has a heat sink to dissipate heat generated by its operation.

rather obvious add-ons that are necessary to keep the system functioning reliably. Like the 20386, the 25386 has 600MB of hard-disk capacity. Its three half-height and two full-height bays provide all the expansion room anyone is likely to need.

The 25386's system-board design, however, is notably different from that of the 20386. Gone is the daughter-board that housed the 386, 387, cache controller, and the 32KB SRAM cache. Instead, the processor, coprocessor, and the cache and its controller are integrated onto the system board with 1MB of dynamic RAM (DRAM).

The system-board memory consists of four banks of nine 256 Kbit chips, rated at 60 ns. These chips are socketed, as are the 25-ns SRAM chips that make up the high-speed memory cache. Many of the logic chips on the system board are also socketed, and no surface-mount technology is evident.

The 25-MHz 386, which is located at the bottom center of the system board, apparently generates more heat than the 20-MHz component used in the 20386. In a conspicuous case of iterative engineering, ALR glued a heat sink on the 386 and installed an auxiliary cooling fan inside the front of the system case. These add-ons are better than allowing key components to overheat, but do not inspire confidence in the thoroughness of the 25386's design.

Unlike the 20386, which uses an Intel 82385 cache controller and a 32KB SRAM cache, the 25386's 64KB cache of 25-ns SRAM is controlled by ALR-proprietary circuitry. This circuitry controls DMA-device access to memory as well as the 386's memory accesses. ALR claims zero-wait-state access to memory 95 percent of the time. The cache is organized as a direct memorymap cache consisting of 16,384 double word (4-byte) entries. Each entry in the cache can be associated with the location in the same relative position in any one of the 65,536 64KB pages in the system's 4GB address space. The cache performs posted write-throughs and directs all memory-access requests to both the cache and system memory. Thus, it does not incur an additional wait-state penalty for cache misses, as does the 82385 cache controller.

Additional memory is provided on the standard 32-bit RAM board, which has 1MB of extended memory. The user can add three memory modules, either 1 or 4MB, to the board, allowing system memory size to be 2–8, 10, 11, or 14MB. The board fits into a special slot at the bottom of the system board.

The system board features one PC-type, 8-bit expansion slot; six AT-type, 16-bit slots; and, of course, the two-connector 32-bit memory slot. The top 16-bit slot holds the hard-disk controller. The next 16-bit slot accepts the diskette controller/serial interface and parallel interface board, and the video controller occupies another 16-bit slot. This leaves one 8-bit and three 16-bit slots available.

Although the 25386 has AT-type expansion slots, the expansion bus is not fully AT compatible. ALR chose simplicity (for itself) over compatibility by running the bus at 8.33 MHz (one-third of the CPU clock rate). While most expansion boards run satisfactorily at this rate, there are no guarantees. Expansion boards need to be checked carefully to ensure that they operate correctly in the system.

The standard 16-bit VGA works without problem on the expansion bus, and it makes the 25386 seem fast compared to an EGA-equipped 20386. It is similar in appearance and performance to Compaq's Video Graphics Controller, which uses the Paradise VGA chip set.

The ESDI hard-disk controller has a 16KB buffer, allowing full track buffering. It uses a 1:1 interleave, controls two disk drives, and requires one 16-bit expansion bus slot.

The system board, VGA, hard-disk controller, and combination diskette controller/serial and parallel interface board contain jumpers and switches, most of which are set at the factory.

System-board configuration switches identify the type of display installed, the presence and speed (20-or 25-MHz) of the 387, whether or not system ROM is copied to RAM, and whether the CPU is to operate at normal (25-MHz) or low speed. During low-speed operation, the memory cache is disabled and hold cycles are

inserted between CPU memory accesses, yielding performance equivalent to that of an 8-MHz system.

With the configuration switch set for normal operation, the user can initiate low speed (required by some software packages) by pressing Ctrl-Altminus when the system is operating; pressing Ctrl-Alt-plus restores 25-MHz operation (the plus and minus keys on the numeric keypad must be used). When the system is reinitialized, 25-MHz operation resumes automatically.

#### SUFFICIENT SOFTWARE

ALR provides a setup diskette and the Phoenix Control/386 software diskette with the 25386. The setup diskette includes setup utilities, diagnostics programs, and a utility for setting system speed. Control/386 provides disk caching, copying, and mapping of system and VGA BIOS from ROM to 32-bit RAM, and the use of extended memory as expanded memory.

A generic version of MS-DOS 3.3, which includes the GW-BASIC interpreter, is available at extra cost. ALR does not offer OS/2, but advises users requiring OS/2 to acquire IBM's version. IBM's OS/2 Standard Edition 1.0 can be installed and run on the 25386 with judicious use of the system speed switch; however, due to the hardware-specific nature of OS/2, it will be difficult indeed for ALR to maintain compatibility with IBM's OS/2.

Documentation included with the 25386 consists of the *FlexCache 25386 User's Manual* and the *User's Guide to Control/386*. These manuals provide system setup and operation information comparable to that provided in IBM's and Compaq's standard documentation. IBM and Compaq provide technical reference manuals for an additional fee, but ALR does not even publish this type of information.

#### **ALR FLEXCACHE 25386 VITAL STATISTICS**

\*Model 150: \$9,499

25-MHz Intel 80386 microprocessor 2MB memory

64KB SRAM memory cache Intel 80387 math coprocessor socket Realtime clock

Serial and parallel interfaces 16-bit VGA adapter

5.25-inch 1.2MB diskette drive 150MB ESDI hard disk 101-key enhanced keyboard

Model 300: \$12,499

All features of Model 150 except with a 300MB ESDI hard disk

Available options:

1MB memory module: \$1,049 4MB memory module: available in the first quarter of 1989

\*80387 math coprocessor (25-MHz version): \$1,795

Additional 150MB disk drive: \$2,499 Additional 300MB disk drive: \$3,999 \*3,5-inch 1.44MB diskette drive: \$225

150MB streaming tape backup drive: \$1,890

\*MS-DOS/BASIC 3.3: \$120

An asterisk indicates the model reviewed and the options included.

### COMPAQ DESKPRO 386/25

#### How to pack 25 MHz of power into a 4.77-MHz case.

Like the similarity between the ALR machines, Compaq's entry into the 25-MHz market is quite similar to the Deskpro 386/20. The older machine, introduced in September 1987, was the first 386 equipped with memory caching. With the Deskpro 386/25, Compaq has essentially decided to stay with a pat hand and concentrate mainly on boosting the clock speed to 25 MHz.

The 386/25 does have some subtle differences, though. The crystal oscillator is now 50 MHz instead of 40 MHz as on the 386/20. Most of the chips on the system board are surface-mounted, indicating Compaq's continuing approach to fully automated assembly. The only socketed items are the ROM BIOS, the Intel processors (80386, 82385, and optional 80387), and the optional Weitek 3167. Compaq chose the 25-MHz 82385 controller to manage the 32KB of 25-ns SRAM cache memory. A third Intel 25-MHz processor, the 80387, is optional.

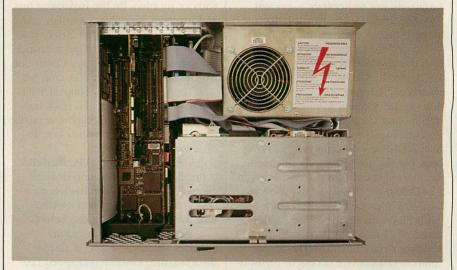
Compaq abandoned the Weitek coprocessor board introduced with the 386/20 machine, but has not abandoned Weitek. The old Weitek board, with its three custom-integrated circuits and monstrous heat sinks, has been replaced with a single Weitek integrated circuit, the Weitek 3167—a super floating-point coprocessor.

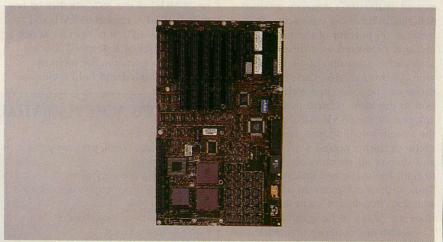
Announced in June, the Weitek 3167 is the new coprocessor of choice for 386 systems that perform intensive floating-point arithmetic. Offering all the functions of the old three-chip coprocessor board, the 3167 is an option on the Sun 386i workstation from Sun Microsystems Inc., as well several other high-performance 386 systems. Offering two to four times the performance of a 387, the chip is supported by CADKEY from Manufacturing and Consulting Services and CADMAX TrueSurf from Vector Automation. The Lahey F77L FORTRAN compiler and 386/WEITEK MATLAB from the Math Works NAG also support the chip.

#### **COMPLETE COMPONENTS**

In addition to fast processors and coprocessors, the Deskpro 386/25 has other state-of-the-art devices designed







The Compaq Deskpro 386/25 features the same desktop system-unit design that was introduced with the release of the original Compaq Deskpro back in 1984.

The Deskpro 386/25, with its AT-style system unit, contains a number of ribbon cables. The system memory board is installed on the left of the system unit.

The 25-MHz 386 is located in the bottom center of the system board (the 387 is on the left). The socket above the 387 is for the Weitek 3167 math coprocessor.

to maximize system performance. The disk controller, an enhanced small device interface (ESDI) made for Compaq by Western Digital, features a 16KB buffer with 1:1 interleaving. Communicating over the standard 16-bit AT bus. it can control two hard-disk drives and two diskette drives.

The video controller is Compag's version of the VGA standard. Unlike other VGAs, the Compaq controller operates on the 16-bit AT bus rather than the 8-bit PC bus, doubling the speed data can be passed to the video memory and greatly enhancing the writing speed of the video display.

Compaq remains faithful to the AT bus. The Deskpro 386/25 contains five 16-bit AT bus slots and two 8-bit PC bus slots. A proprietary bus for the memory board provides a 32-bit, 25-MHz data path between the processing chips and system memory. All system memory is contained on this board. One 16-bit slot is reserved for the disk controller. The VGA controller also occupies a 16-bit slot, leaving two 8and three 16-bit expansion slots free.

The Deskpro 386/25, like all computers in the Deskpro series, has four half-height, 5.25-inch bays for storage devices. All bays have external access, allowing for a varied arrangement of storage devices. The 386/25 comes with a 5.25-inch 1.2MB drive and either a half-height 110MB drive or a full-height 300MB drive. Other devices available include a 3.5-inch 1.44MB diskette drive, a 40MB tape backup, and a 135MB tape backup. All devices except the 135MB tape backup are controlled by the Western Digital controller.

Although 300MB of disk storage is adequate for most desktop uses, it is frequently not enough for many network and multiuser system applications. To address these needs, Compaq introduced a 300/600MB Fixed Disk Drive Expansion unit.

This unit is similar in appearance to the storage-device bay portion of the 386/25 system unit. Costing \$6,999, it contains a 192-watt power supply, one 300MB full-height ESDI hard disk, and space for a second (for an additional \$6,499). The disk drives are the same as the fast (average access time less than 20 ms) standard hard disk on the 386/25 Model 300. The disk(s) are controlled by a buffered ESDI disk controller, which requires one 8-/16-bit slot in the system unit; a four-foot cable connects the two units.

Two expansion units can be connected to any Deskpro 386, 386/20, or 386/25, for a total hard-disk storage

capacity of over 1.2GB. If two expansion units are used, the system's hard disk must be disabled or removed.

The 386/35's power supply is rated at 192 watts steady state with a 220-watt peak. A parallel port and a serial port are standard, as is a realtime battery clock. The parallel and serial interfaces are on the same board as the disk controller, saving a valuable expansion bus slot. The keyboard, which imitates the IBM enhanced 101-key layout, has the standard Compaq feel with audio feedback via the computer speaker.

### COMPLETE SOFTWARE, TOO

MS-DOS 3.3 or Compag's edition of OS/2 are optional with the 386/25. MS-DOS (as published by Compaq) supports logical disk drives (volumes) up to 512MB in size; OS/2 logical drive size, however, is limited to 32MB. Standard software includes Compaq's version of the DOS MODE command, the Compaq Expanded Memory Manager (CEMM), CACHE, and 386SETUP.

Compaq's MODE command allows the 386/25 to run at simulated speeds comparable to that of several popular computers including 6-, 8-, and 12-MHz 286 speeds, and 16-MHz 386 speed. As on previous Compaq 386 models, the MODE SPEED = AUTO command enables simulated 8-MHz operation during diskette accesses, but normal (25-MHz) operation otherwise.

Compaq's expanded memory manager (CEMM) allows the user to arrange the extended memory above the

640KB barrier as either extended or expanded memory. Because CEMM is a virtual memory manager, Windows/386 will not operate when CEMM is used because both programs want to be the only virtual-memory manager.

CACHE, Compaq's disk-caching program, can substantially improve the performance of the system during processes that involve a lot of disk reading and writing. The cache can exist in base, extended, or expanded memory, but the best performance is achieved in extended memory. The user can install CEMM, CACHE, and VDISK (one or more virtual disks) with 386SETUP. Compaq also provides a full set of hardware diagnostics.

The 386/25 operations guide is an upgraded and reorganized version of the 386/20's manual. It is divided into two sections—Getting Started and Technical Overview. The first one covers installing, testing, and using the computer; the second is an overview of the technical features and functions of the system, including operating and performance specifications for components. Documentation for CEMM, CACHE, 386SETUP, and other Compaq-supplied user programs is contained in the Supplemental Software Guide.

Detailed technical information on systems functions and performance is provided in the optional Technical Reference Guide. VGA applications developers also will be interested in the Video Graphics System Technical Reference Guide, available at extra cost.

# COMPAQ DESKPRO 386/25 VITAL STATISTICS

Model 110: \$10,299

25-MHz Intel 80386 microprocessor 1MB memory

32KB SRAM memory cache

Intel 80387 math coprocessor socket

Weitek 3167 math coprocessor socket

Realtime clock

Serial and parallel interfaces

5.25-inch 1.2MB diskette drive 110MB hard-disk drive with ESDI

controller

101-key enhanced keyboard

\*Model 300: \$13,299

All features of Model 150 except with a 300MB ESDI hard disk

Available options:

1MB, 100-ns memory module: \$549 \*4MB, 100-ns memory module: \$2,099 4MB system memory board: \$2,999 \*80387 math coprocessor (25-MHz

version): \$1,899

Weitek 3167 coprocessor (25-MHz

version): \$2,599

\*Compaq Video Graphics Controller Board: \$599

\*Compaq Video Graphics Color Monitor: \$699

Compaq Video Graphics Monochrome Monitor: \$255

Compaq Video Display Controller Board: \$199

Compaq Dual-mode Monitor: \$255 300/600MB expansion unit: \$6,999

Additional 300MB disk drive: \$6,499 5.25-inch 360KB diskette drive: \$225 3.5-inch 1.44MB diskette drive: \$245 40MB tape backup drive: \$799

\*135MB tape backup drive: \$1,999

\*MS-DOS/BASIC 3.3: \$95

\*MS-OS/2 Standard Edition 1.0: \$325 \*Compag Deskpro 386/25 Technical Reference Guide: \$149

\*Compaq Video Graphics System Technical Reference Guide: \$79

An asterisk indicates the model reviewed and the options included.

# EVEREX STEP 386/25

# It has the speed and performance, but is it street legal?

Everex, like ALR, realizes that it has to distinguish itself from larger manufacturers to overcome name-brand loyalty. It has to offer some incentive, such as high performance at a lower price, to attract the cautious buyer.

From the outside, the Everex Step 386/25 is attractive and is the only machine with a speedometer—a set of indicator lights for power, system speed, and disk access, plus an eight-character LED display. During boot up, the LED displays names of the power-on self tests (POST) as they execute. Once the machine is running, the display lists the location of last disk-drive access (drive, track, and sector).

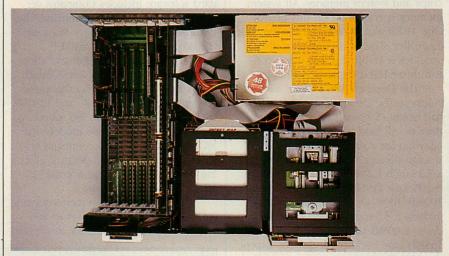
Convenient push-button switches on the front panel reset the system (without turning off the power) and disable the speaker output. A slide switch controls system speed. When set to the top (25-MHz) position, the system runs at that speed; when set to the bottom (8-MHz) position, the system runs at 8.33 MHz. When set to the middle position, the system runs at 25-MHz at boot-up but can be switched up or down one speed (including an intermediate 12.5-MHz speed) using Ctrl-Alt-minus and Ctrl-Alt-plus (the plus and minus keys on the numeric keypad must be used).

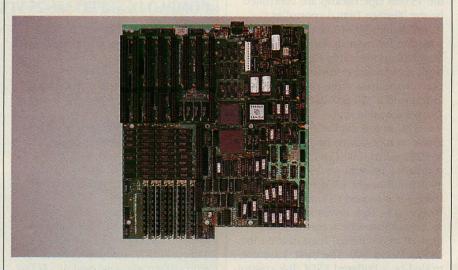
Pulling the top off of the Step 386/25 reveals a machine that is less polished than the Compaq or IBM. The casing edges are a little rough, the disk-drive mounts look fragile, and the system has no surface-mounted chips (most components are socketed). These imperfections do not affect speed or performance, but the extensive use of socketed components may affect long-term reliability.

### CACHE TO SPARE

Everex's first Step computer, the 386/20, used Everex's proprietary Advance Memory Management Architecture (AMMA) and a proprietary memory-cache controller to achieve performance numbers that briefly let it claim the "fastest PC" title. The 386/25 uses the same controller, with its speed increased to 25 MHz.







A control panel that contains an LED display, indicator lights, a reset switch, and a speaker-disable switch dresses up the front of the Step 386/25 system unit.

Disk and diskette drives connect to their controller via ribbon cables. The socket for the optional 387 coprocessor is located beneath the cables near the center.

The second slot from the right is used for the Everex proprietary 32-bit memory expansion board; the slot also can be used for an 8-bit PC-type adapter board.

The Everex controller differs significantly from the Intel 82385. The Everex controller employs a write-back scheme (as opposed to the 82385's write-through scheme) for maintaining cache coherency.

To ensure cache coherency in all systems, data in the main memory must be identical to the corresponding data in the cache. In systems using the Intel 82385, this is accomplished by a writing-through process.

The Everex controller, on the other hand, reduces the number of times new data are written to main memory. With its write-back scheme, changes to data in the cache initially are written to the cache only. An indicator bit is switched from zero to one to indicate that the cache memory is different from the main memory. If, during later operations, the computer needs to load new data into the cache, the changed data are first written back to main memory.

The Everex controller also intercepts all incoming requests—including direct-memory access (DMA) requests—for data from main memory to ensure no stale data are passed on. The Everex AMMA scheme dedicates a block of the cache to a block of the main memory. In this way, when the system needs data from main memory, it checks only the cache block associated with the main-memory block.

A new 64KB bank of cache memory is added each time a new bank of memory is added (either to the system board or to the 32-bit memory expansion board). This expansion capability is important because Everex's scheme assigns a block of cache memory to every block of main memory.

The standard disk controller with the Step is the Everex EV-341 caching controller, with 512KB of 120-ns onboard memory. Each time a hard disk is accessed, a full track of data is read and stored in the cache for reference.

Like everybody but IBM, Everex continues to support the AT bus. The Step 386/25 contains six 16-bit AT bus slots and two 8-bit PC bus slots. One of the 8-bit slots doubles as the 32-bit slot for use with the Everex memory expansion board. In a standard configuration, the disk controller and a video controller occupy 16-bit slots, while the serial/parallel port board and the 32-memory board fill the 8-bit slots, leaving four AT slots open.

For all Step computers, Everex derives the clock for the expansion bus by dividing the system clock either by two or three. Thus, the Step 386/25's

expansion bus runs at either 8.33 or 12.5 MHz instead of the 8-MHz standard of the AT bus. The user sets the divisor in the EEPROM SETUP program; it can be altered only by rebooting the machine and invoking SETUP.

The Everex system accommodates two banks of four single in-line memory modules (SIMMs) and 128KB of cache memory on the system board. Depending on the size of the SIMMs (256KB or 1MB), the system board can hold a total of 2MB or 8MB of RAM.

Each bank of memory on the system board has a corresponding 64KB bank of cache memory. Because the SRAM chips that make up the cache are sensitive to static electricity, Everex recommends that system-board memory upgrades be performed only by an authorized Everex dealer.

The optional 32-bit memory expansion board is offered with eight 256KB or 1MB SIMMs, yielding a capacity of 2MB or 8MB. In both cases, the board contains two banks (128KB) of 25-ns cache memory.

The Step 386/25 has one bay with external access that contains three halfheight, 5.25-inch storage devices. The second internal bay is full-height, 5.25 inches. A 5.25-inch 1.2MB drive is standard. Options include a 3.5-inch 1.44MB diskette drive, a 40MB tape backup, and a 130MB hard-disk drive. The Everex caching controller can operate as many as four devices (two hard disks and two diskette drives). Everex also offers an ESDI disk controller in place of the EV-341 at no extra cost. This board, when used with the 300MB ESDI disk drive, provides a mass storage capacity of over 600MB.

The power supply is rated at 200 watts. A parallel port and a serial port are standard. The 386/25's keyboard is

the Maxiswitch ME-101 (the same provided with the ALR). Everex, however, chose not to provide audio feedback.

Unlike the other three computers tested, which had VGAs, the Everex review unit had an EGA controller and monitor. While the image was extremely sharp, an EGA controller is inherently slower than a VGA controller, which features a high-speed video RAM (VRAM) display buffer.

The Step 386/25's two setup utilities are stored in system ROM. The utility that modifies the system's CMOS configuration RAM is used to specify parameters such as number and type of disk and diskette drive. The Everex EEPROM SETUP program allows parameters such as the number and capacity of memory banks to be set without the use of jumpers or switches.

### **SMALL-CHANGE MANUALS**

Everex, like most smaller manufacturers, produces minimal documentation on its products. Only a single operations manual comes with the 386/25 (the standard Microsoft manual is provided with MS-DOS 3.3). The manual consists of a system user's guide, a hard-disk installation guide, a guide to the use of the Everex disk cache and RAM disk software, and a guide for the serial/parallel port board.

Strangely, information specifically for new users is near the back, rather than the front of the user's guide. Moreover, the caching disk controller is not described anywhere in the operations manual even though it is the standard controller.

Everex provides no system diagnostic or test software other than the POST. MS-DOS 3.3 comes standard with the Step 386/25 and Everex offers MS-OS/2 as an option.

# **EVEREX STEP 386/25 VITAL STATISTICS**

\*STEP 386/25: \$6,399

25-MHz Intel 80386 microprocessor 1MB memory

64KB SRAM memory cache Intel 80387/Weitek coprocessor socket Realtime clock

8-character LED status display Serial and parallel interfaces Hard-disk controller

1.2MB diskette drive 101-key enhanced keyboard

MS-DOS/BASIC 3.3 STEP 386/25-4MB: \$9,599

Same features as above except with four 1MB SIMMs instead of four 256KB SIMMs Available options:

\*Manage optons.

\*1MB system board memory: \$600

4MB system board memory: \$4,500

\*2MB, 32-bit memory board: \$1,599

8MB, 32-bit memory board: \$8,599

\*80387 coprocessor (25-MHz): \$1,395

Weitek coprocessor board: \$1,995

\*Everex EGA adapter: \$160

\*Everex EGA color display: \$399 \*160MB disk drive: \$2,399

300MB disk drive: \$2,995

3.5-inch 1.44MB diskette drive: \$175 125MB tape backup drive: \$1,495 MS-OS/2 Standard Edition 1.0: \$299

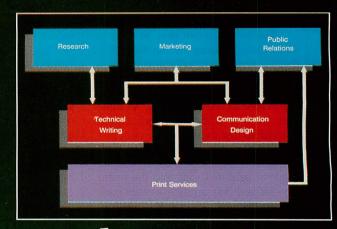
An asterisk indicates the model reviewed and the options included.

SEPTEMBER 1988 73

# Powerful.

The SAS System brings today's power-hungry PC users efficient data management, an easy report generator, customized presentation graphics, superior statistics, and more. You get the strength and flexibility that make SAS software so indispensable on mainframes and minicomputers.

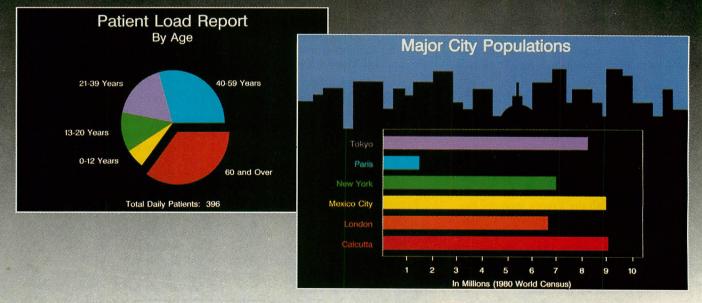




# Productive.

The SAS System has integrated applications to use "as is" or customize to fit your needs. Plus a built-in micro-to-host link just for your PC.

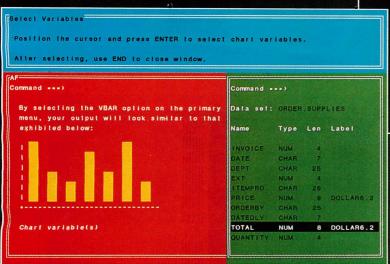
Read data in any format from any file including dBASE® and Lotus® 1-2-3.® Then analyze and display your data through interactive windows.

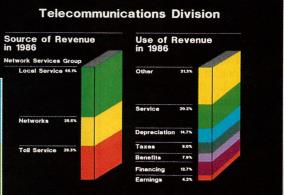


The SAS System runs on the IBM PC AT, XT, and PS/2; IBM 370/30xx/43xx and compatible mainframes; Digital Equipment Corporation's VAX™ series minicomputers and workstations; Data General Corporation's ECLIPSE® MV series; and Prime Computer, Inc.'s 50 series. Not all products are available for all operating systems.

SAS is the registered trademark of SAS Institute Inc., Cary, NC, USA. dBASE is a registered trademark of Ashton-Tate. Lotus and 1-2-3 are registered trademarks of Lotus Development Corp. Copyright © 1987 by SAS Institute Inc.

# System.



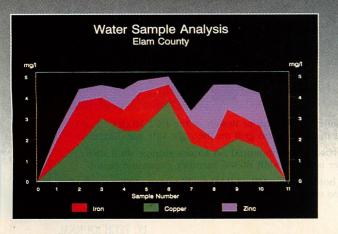


# Prove it on Your PC.

# Personable.

The SAS System simplifies applications development with a new menu-building tool. Even first-time users will find it easy to analyze, report, and display data...just by filling in the blanks.

Maintaining the SAS System is easy, too. You receive automatic updates and technical support. And high-quality training is available direct from SAS Institute.





SAS Institute Inc. SAS Circle □ Box 8000 Cary, NC 27512-8000 Phone (919) 467-8000 Fax (919) 469-3737

I'd like to know more about the SAS® System for personal computers. Send me a free demonstration diskette, plus details about a free 30-day software trial.

| Name            |                                   |
|-----------------|-----------------------------------|
| Title           | ed and server server, and did     |
| Company         | Parties of a virtual employed for |
| Mailing Address | numer and laterally instante      |
| City            | (Sea) and beautiful about         |
| State           | ZIP                               |
| Telephone       | SILVARIDO CARLO E E ESPA          |

Mail to: SAS Institute Inc. Attn: CC SAS Circle □ Box 8000 Cary, NC 27512-8000

# IBM PS/2 MODEL 70-A21

# This pint-sized powerhouse is the fastest PS/2 yet.

Unlike the ALR, Compaq, and Everex products, which are refinements of existing models, the IBM Model 70-A21 is a wholly new system. Announced 14 months after the April 2, 1987, introduction of the PS/2 series of computers, the A21 is one of three new desktop 386 systems that IBM hopes will carve out a substantial share of the 386 market, which Compaq now dominates.

The Model 70 series includes the 16-MHz entry-level E61, the 20-MHz intermediate-level 121, and the 25-MHz advanced A21. All three machines feature a 386 processor and optional 387 math coprocessor, 32-bit memory expandable to 16MB, and an ESDI hard disk with integrated controller. The E61 features a 60MB hard disk and the 121 and A21 come with a 120MB hard disk.

The Model 70-E61 and -121 are available now; the A21 is scheduled to be available in the third quarter of 1988. The A21 reviewed was examined and tested prior to general availability. Assuming the production A21 performs as well as the review unit, then IBM uncharacteristically has produced a very high-performance computer.

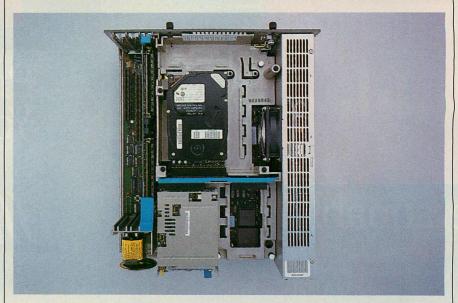
The Model 70s are nearly identical in appearance to the Model 50 and the new zero-wait-state Model 50Z, which was announced at the same time as the Model 70s. The only distinguishing features are the extra ventilation slots on the right side of the system-unit cover and the Model 70 386 label on the oval-shaped IBM PS/2 logo.

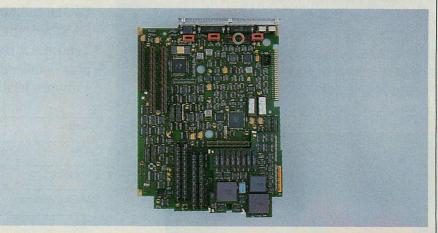
### **INSIDE THE BOX**

The Model 70 bears a resemblance to the Model 50 on the inside as well. The interior contains no connecting cables. The system board is plugged directly into the power supply, and the hard-disk and diskette drives receive power and control signals from the system board through a special interposer printed circuit board. The Model 70 supports a single hard-disk drive (the 120MB unit, with its integrated ESDI, is the only one offered by IBM).

One 3.5-inch 1.44MB diskette drive is standard on the Model 70; a second 1.44MB diskette drive and an external 5.25-inch 360KB diskette drive







The Model 70 features the same small-footprint design as the PS/2 Model 50 and Model 50Z; only its logo and the ventilation grill on the right side are different. The Model 70-A21's 120MB hard disk is mounted on a mass storage shelf above the system board. Shown here is the 2–8MB 80386 memory expansion board. The Model 70 system board holds up to 8MB of RAM and has two 32-bit slots and one 16-bit slot with video extension Micro Channel expansion connectors.

are optional. The A21's 25-MHz 386 processor (visible through the opening in the right diskette-drive bay), the Intel 82385 memory cache controller, the 64KB SRAM cache, and the optional 387 math coprocessor are mounted on a daughterboard attached to the system board. The daughterboard attaches with two 2-by-40-pin connectors.

IBM's creative use of the 82385 allows it to control a two-way associative 64KB memory cache, rather than the 32KB cache used on the Deskpro 386/25. The A21 accomplishes this by directing one less low-order address line to the 82385 than normal and fetching eight rather than four bytes each time a cache miss occurs. This improves performance because memory references tend to be clustered, with one miss following another.

System-board memory consists of one to four 2MB SIMMs. The snap-in, snap-out SIMMs have an 80-ns access time. System-board memory is arranged in 2KB pages as on the E61 and 121. Thus, a memory read can take as little as 80 ns (zero wait states) if the information requested is in the cache, or as much as 280 ns (five wait states) if both a cache miss and a memory-page miss occur. Memory writes are buffered outside the CPU and occur at zero wait states as long as a cache miss or other memory-write operation does not occur before the current write operation completes.

The user can add memory to the Model 70 using a 2–8MB 80386 memory-expansion board, which comes with one 85-ns 2MB SIMM and accommodates three additional 85-ns SIMMs. Either 1MB or 2MB SIMMs can be used, with no switch setting required. The board requires a 32-bit Micro Channel slot; multiple boards can be installed to provide a maximum 16MB of system memory. The memory-expansion board can be used on the PS/2 Model 80 as well as the Model 70.

IBM's ability to put a large amount of logic into a small space is apparent in the A21 system board. With extensive use of surface-mount technology and efficient use of the vertical and horizontal space, IBM made the system board small enough to fit into the small footprint of the Model 50. Several components, including the SIMMs and the VGA video memory, extend above the system board by more than one inch, without contacting or interfering with the mass-storage device shelf above them. All vertically mounted components are firmly attached to the system board and should not hinder

the reliable operation of the system; IBM and its dealers, however, will have to take extra care to ensure that these parts are not damaged during shipping.

The Model 70 features the same VGA used on previous models, unfortunately still with an 8-bit interface. Apparently, higher-performance video will not be standard on a PS/2 until IBM decides to integrate 8514/A-type capabilities onto the system board.

Like other PS/2s, the Model 70 system board holds the VGA, serial, parallel, mouse, and keyboard ports. IBM has added coils to Model 70 ports to help control electrical emissions.

The Model 70 system board has three Micro Channel slots—one 16-bit connector with video extension and two 32-bit connectors. The 16-bit Micro Channel adapters (other than video adapters) can be used in the 32-bit and 16-bit connectors. The 2–6MB 80386 memory-expansion board originally offered with the Model 80 can be installed in one of the Model 70's 32-bit expansion slots; however, the Model 70 ignores any matched memory-cycle requests from the board.

### PERTINENT PAPERS

Like all PS/2s, the Model 70 is well documented. The quick-reference guide provides IBM's usual pictorial and verbal explanations of setup, installation of options, and simple troubleshooting. It also documents a new error message that appears on the display screen when the system detects an error. Con-

sisting of the international symbol for "no" or "not" (a circle with a slash through it) superimposed over the letters "OK" and an arrow pointing to a representation of an IBM manual, the message means "the system is not okay, consult the manual." The quick-reference guide offers the simplistic advice that the system unit should be serviced if this message is encountered.

The Model 70 Reference Diskette contains the same tutorial, setup, and diagnostic programs provided with other Micro Channel-equipped PS/2s. The advanced diagnostics documented in the *PS/2 Hardware Maintenance Service* manual can be accessed by pressing Ctrl-A after booting the system using the Reference Diskette.

Technical information on the Model 70 and its various submodels is available at extra cost in the IBM PS/2 Hardware Interface Technical Reference. This manual, intended for developers of PS/2 hardware and software products, provides information on the Micro Channel architecture and the PS/2 Models 50, 60, 70, and 80. BIOS information is available in the IBM Personal System/2 and Personal Computer BIOS Interface Technical Reference.

IBM provides technical information on the 120MB hard disk and 2–8MB 80386 memory-expansion option in separate technical references. Maintenance information is provided on supplements to the *PS/2 Hardware Maintenance Reference* and *Hardware Maintenance Service* manuals.

# IBM PS/2 MODEL 70-A21 VITAL STATISTICS

\*Model 70-A21: \$11,295

25-MHz Intel 80386 microprocessor

2MB memory 64KB SRAM memory cache

Intel 80387 coprocessor socket

Realtime clock

Video Graphics Array

Serial and parallel interfaces

Mouse interface

3.5-inch 1.44MB diskette drive

120MB ESDI hard disk

101-key enhanced keyboard

Available options:

2MB, 80-ns system-board memory module: \$1,495

\*2–8MB 80386 memory-expansion

board: \$1,695

1MB, 85-ns expansion-board memory

module: \$695

\*2MB, 85-ns expansion-board memory module: \$1,395

\*80387 math coprocessor (25-MHz version): \$2,395

8514/A display adapter: \$1,290 8514/A display-adapter memory

expansion: \$270

8503 monochrome display: \$275

8512 color display: \$595

\*8513 color display: \$750

8514 color display: \$1,550

Second 3.5-inch 1.44MB diskette

drive: \$245

5.25-inch 360KB external diskette

drive: \$335

5.25-inch external diskette-drive

adapter/A: \$70

\*PS/2 Mouse: \$95

6157 Model 1 streaming-tape backup

drive: \$1,750

PS/2 6157 tape drive interface/A: \$350

\*IBM PC-DOS/BASIC 3.3: \$130

\*IBM OS/2 Standard Edition 1.0: \$325

\*IBM PS/2 Hardware Interface Technical Reference: \$125

An asterisk indicates the model reviewed and the options included.

SEPTEMBER 1988 77

# ONE NAME KEEPS THEM WORKING TOGETHER:

THOMAS-CONRAD.



CIRCLE NO. 158 ON READER SERVICE CARD

Thomas-Conrad Corporation 8403 Cross Park Drive Austin, Texas 78754 (512) 836-1935 (800) 332-8683

ARC and ARCNET are registered trademarks of Datapoint Corporation.

# **CRUISING ALONG**

# They are fast, but don't let the speed blind you.

Commonly used software and hardware products were installed on all four 25-MHz machines to test for compatibility, and PC Tech Journal's new high-level benchmark series (given in "High-level Measurements") was used to measure their respective performances.

All of the software programs worked without incident or error on all of the machines (see table 2), indicating the systems are all highly compatible with the IBM AT standard. This degree of compatibility is particularly impressive for the Model 70, considering how different its internal hardware design is from that of the AT.

Graphics software ran extremely well on all four machines. Microsoft Windows/386 2.03 and Word 4.0 were both particularly responsive.

Four memory-resident programs were tested. Borland's SideKick 1.56A and 1.16A, Turbo Lightning 1.01A, and Living Videotext's Ready! 1.00E all performed satisfactorily. Ready! was tested with expanded memory provided by using 386 memory-management software in conjunction with the system's extended memory. Vendor-provided 386 control software was used on the FlexCache 25386, Deskpro 386/25, and Step 386/25; 386-to-the-Max from Qualitas was used on the Model 70.

Fastback Plus 1.00, from Fifth Generation Systems, which is used to test the DMA access capabilities of each system, found all four systems to its liking and worked without incident. (For a review of Fastback Plus, see Product Watch, R. Martin Temple, p. 127.)

Testing the systems with commonly used hardware products reveals differences in the systems and the approach the manufacturers have taken to compatibility. The Microsoft serial mouse worked on all four systems. The Microsoft bus mouse and the other ATbus adapter boards were not tested on the Model 70, because they are not compatible with its Micro Channel expansion bus. The bus mouse worked satisfactorily on the three systems compatible with the AT bus.

ALR's proprietary 32-bit memory board is the only option for extended memory on the FlexCache. Thus, it will

**TABLE 1:** Features Summary

|                                   | ALR<br>FLEXCACHE<br>25386 | COMPAQ<br>DESKPRO<br>386/25  | EVEREX<br>STEP<br>386/25 | IBM PS/2<br>MODEL<br>70-A21 |
|-----------------------------------|---------------------------|--|--------------------------|-----------------------------|
| PRICE"                            | \$9,499                   | \$11,447   | \$9,797                  | \$11,295                    |
| PROCESSORS                        |                           |  |                          |                             |
| CPU                               | 80386                     | 80386  | 80386                    | 80386                       |
| Coprocessor                       | 80387                     | 80387 <sup>b</sup>   | 80387 <sup>c</sup>       | 80387                       |
| Clock rate of processors (MHz)    | 25                        | 25   | 25                       | 25                          |
| MAIN MEMORY (32-bit data path)    |                           |  |                          |                             |
| Base memory size (MB)             | 2                         | 1000   | 1<br>8 <sup>d</sup>      | 2                           |
| System board capacity (MB)        | 1                         | 0  |                          | 8                           |
| 32-bit memory board capacity (MB) | 13                        | 16   | 8                        | 8                           |
| Memory speed (ns)  CACHE MEMORY   | 60                        | 100  | 120                      | 80 <sup>e</sup>             |
| Controller                        | $ALR^f$                   | 82385  | Everex f                 | 82385                       |
| Cache size (KB)                   | 64 64                     | 32   | 64 to 256                | 64                          |
| Cache speed (ns)                  | 25                        | 25   | 25                       | 30                          |
| DISK DRIVE CONTROLLER             | 2)                        | 4)   | 2)                       | 30                          |
| Capacity (hard disk/diskette)     | 2/2                       | 2/2  | 2/2                      | 1/2                         |
| Hard-disk interleave              | 1:1                       | 1:1  | 1:1                      | 1:1                         |
| Onboard buffer (KB)               | 16                        | 16   | N/A                      | 11//00                      |
| Onboard cache (KB)                | N/A                       | N/A  | 512                      | N/A                         |
| STORAGE DEVICE BAYS               | Transitation              | lemite   | 47 ABE                   |                             |
| 5.25-inch (half/full height)      | 3/2                       | 4/0  | 3/1                      | 0                           |
| 3.5-inch only                     | 0                         | 0  | 0 7 10 1                 | 2                           |
| DISPLAY CONTROLLER                |                           |  |                          | 4706257278015804325680      |
| Type                              | VGA                       | VGA  | EGA                      | VGA                         |
| Data path (bits)                  | 16                        | 16   | 8                        | 8                           |
| EXPANSION BUS                     |                           |  |                          |                             |
| Туре                              | AT                        | AT   | AT                       | MCA                         |
| Speed (MHz)                       | 8.33                      | 8  | 8.33/12.5                | 10                          |
| AVAILABLE EXPANSION SLOTS         |                           |  |                          | charm                       |
| 8-bit                             | 1012170                   | 2  | 0                        | 0                           |
| 16-bit                            | 3                         | 3 0 0  | 4                        | 1 2                         |
| 32-bit                            |                           | NAMES AND ADDRESS OF THE OWNER, OF THE OWNER, OF THE OWNER, OWNER | 0                        |                             |
| POWER SUPPLY (watts)              | 200                       | 192  | 200                      | 132                         |
| ELECTROMAGNETIC COMPATIBILITY     |                           |  |                          |                             |
| FCC Class                         | A                         | В  | В                        | В                           |
| DIMENSIONS                        |                           | 10.0   | 01                       | 1/1                         |
| Width (inches)                    | 7.5                       | 19.8   | 21                       | 14.1                        |
| Depth (inches)                    | 17                        | 16.5   | 16.5                     | 16.5                        |
| Height (inches)                   | 26                        | 6.4  | 6.5                      | 5.5                         |
| Weight (lbs.)                     | 75                        | 42   | 39                       | 21                          |

The price is for a unit with one diskette drive, a 100MB or larger hard disk, 2MB of memory, and a high resolution (640 pixel-by-350 pixel) color graphics controller (VGA or EGA). The Deskpro 386/25 also can use the Weitek 3167 coprocessor. The Step 386/25 also can use the Everex Weitek 1167 coprocessor board.

Using 1MB RAM modules

Expansion board memory has 85-ns access time.

Proprietary cache-controller

All systems feature a memory cache to provide zero-wait-state memory access in most cases. All except the FlexCache 25386 support 16MB of 32-bit memory.

not access the Cheetah or Intel Above Board 286 extended-memory boards; memory on the Above Board can be used as expanded memory.

All expansion boards functioned normally in the Step 386/25 at both bus speeds. The fast bus speed (12.5 MHz) does improve the performance of fast boards such as the Above Board 286.

All boards functioned normally in the Deskpro 386/25. Compaq adheres faithfully to the AT standard, ensuring compatibility with existing software and hardware. Compaq uses a separate 8-MHz clock for timing on the AT bus, rather than taking the short cut of using a fraction of the CPU clock rate as ALR and Everex do.

79 SEPTEMBER 1988

# In 1988, \$3.5 billion in microcomputer software will be sold worldwide. During that same time, another

\$3.0 billion in sales will be lost to free distribution — better known as software piracy. And right now, Rainbow Technologies' Software Sentinel™ is protecting close to \$1.0 billion in software for developers who never wanted to be part of the free software distribution network in the first place. ( ) The Software Sentinel hardware key is "execution control" software protection. It ships with the software and

simply plugs into the PC's parallel port hundred percent invisible to both user and ware. Users can make as many copies as



to be one the softthey want.

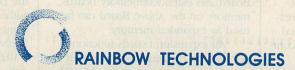
Make working submasters. Use a hard disk. Virtually anything that can be done with unprotected software. Except start freely

distributing Rainbow famlected by the



unprotected software. Except start freely that software to other users. The ily of Software Sentinel products. Severy big to the not-so-big developers of

MS-DOS, OS/2 and Xenix software in worldwide markets. To the cool tune of close to a billion dollars. So far.



# TABLE 2: Compatibility Summary

| 25 STEP 380-25 MODEL 70-021   | ALR<br>FLEXCACHE<br>25386 | COMPAQ<br>DESKPRO<br>386/25              | EVEREX<br>STEP<br>386/25 | IBM PS/2<br>MODEL<br>70-A21 |
|-------------------------------|---------------------------|--|--------------------------|-----------------------------|
| SOFTWARE                      | •                         |  |                          |                             |
| Borland International         |                           |  |                          |                             |
| Lightning 1.01A               | •                         | •  | •                        | •                           |
| SideKick 1.56A                | •                         | •  | •                        | •                           |
| SuperKey 1.16A                | •                         | •  | •                        | •                           |
| Fifth Generation Systems      |                           | 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1 |                          | a single                    |
| Fastback Plus 1.00            | • 047                     | •  | •                        | •                           |
| Living Videotext              |                           |  |                          |                             |
| Ready! 1.00E                  | •                         | •  | •                        | •                           |
| Microsoft Corporation         |                           |  |                          |                             |
| Windows/386 2.03 <sup>a</sup> | •                         | •  | •                        | •                           |
| Word 4.0                      | •                         | •  | •                        | •                           |
| HARDWARE                      |                           |  |                          |                             |
| Cheetah Systems               |                           |  | THE .                    |                             |
| Cheetah Card (with 2.5MB)     | 0                         | •  | •                        | N/A                         |
| Hayes Microcomputer Products  |                           |  |                          |                             |
| 1200B Smartmodem              | •                         | •  | •                        | N/A                         |
| 2400B Smartmodem              | •                         | •  | •                        | N/A                         |
| Intel Corporation             | 3.40                      |  | 429                      |                             |
| Above Board 286 (with 2.0MB)  | •b                        | •  | •c                       | N/A                         |
| Microsoft Corporation         | 1 1 1 1 m                 |  | Mary -                   |                             |
| Bus Mouse                     | 2 225                     | •  | •                        | N/A                         |
| Serial Mouse                  |                           |  | •                        |                             |

<sup>a</sup> Windows/386 will not run if software providing expanded memory using extended memory is used.

The Above Board can be used only to provide expanded memory. The Step 386/25 bus runs at either 8.33 MHz or 12.5 MHz. The Above Board 286 runs at 12.5 MHz.

All four systems demonstrate compatibility with commonly used software. The ALR FlexCache 25386 does not support the Cheetah extended memory board.

### SEE HOW THEY RUN

All four of these 25-MHz systems offer exceptional performance. In fact, they are so fast that they often complete a command before the user has time to think of what to do next. PC Tech Journal's benchmarks reveal that they are 25-percent faster than the 20-MHz Compaq Deskpro 386/20 in most cases, which makes them four to seven times faster than an 8-MHz IBM AT.

The Deskpro 386/25, with its 16-bit VGA, offers the best video performance and is nearly twice as fast as its nearest competitor in the HLWINDOWS and HLTEXT results (see table 3 and figure 1). The Step 386/25, with its EGA, is the slowest of the lot in all the video tests except for HLGRAPH. For that test, it comes out on top because of its lower resolution (640-by-350 pixels versus the VGA's 640-by-480 pixels).

The HLSORT test results are close; the Deskpro, with its 32KB memory cache, is slightly (5-percent) slower than the other three with their 64KB and larger caches. The FlexCache, with

its 64KB cache and 60-ns system memory, posts exactly the same time as the Everex Step, with its 256KB cache and 120-ns system memory.

The results are even closer in the HLFLOAT computation test. The Deskpro, Step, and PS/2 Model 70-A21 turned in identical times of 5.21 seconds, and the FlexCache was only slightly faster at 5.10 seconds.

The HLDISK test shows that all four systems are twice as fast as an 8-MHz AT when disk caching is used on all machines. The AT is slower by an additional factor of two if it does not use disk caching. The Step and Model 70 post times almost identical to that of the 20-MHz Deskpro, while the FlexCache and Deskpro 386/25 are 10percent faster. The Model 70 exhibits by far the slowest disk performance if disk caching is not used.

### **QUALITY AND VALUE**

These four systems vary in quality and offer varying degrees of value depending on the application area. Although it

will never win any beauty contests and is a little rough around the edges, the FlexCache 25386 is a formidable system. It performs extremely well and its 600MB disk storage capacity makes it a good candidate for a powerful LAN server or multiuser-system host.

Because of the FlexCache's size. appearance, and nonstandard keyboard, users are less likely to accept it as a high-performance personal workstation, despite its relatively low cost. Moreover, because of its design compromises (nonstandard bus speed, heat sinks on chips, additional cooling fans, numerous connecting cables in the system unit), potential buyers should test a system exactly as it will be used in day-to-day operation before making any purchase commitments.

The Compaq Deskpro 386/25, on the other hand, is typical of the highperformance computer that everyone has come to expect from Compag. Its price, the highest of the four machines reviewed, is not a complete surprise either. The Deskpro 386/25 performs well and its disk-drive expansion unit supports enough hard-disk storage to satisfy even the most demanding desktop computer user.

The external styling of the Deskpro 386/25, while acceptable in 1984, is now dated. The front-connecting keyboard cable is a nuisance, and its interior, which is filled to the brim with ribbon cables (particularly on models with several diskette drives and a fixed-disk backup unit), is an open invitation to reliability problems and maintenance inconvenience. The diskdrive expansion unit is acceptable as a stop-gap measure that Compaq uses until it develops a smaller high-performance desktop system and a floorstanding system suitable for LAN server and multiuser-system host functions.

The Step 386/25 is a capable system but has some major compromises. In today's market, compatibility is often as important as performance. The Step 386/25's nonstandard 8.33- and 12.5-MHz bus speed raises questions about its AT-bus compatibility. The nonstandard keyboard (the same one used with the ALR) is another impediment. As with the FlexCache, potential users should test a system exactly as it is to be used before making a commitment.

The Step 386/25 also suffers from some of the same ambivalence as the Deskpro 386/25. With its 600MB harddisk capacity, it is suitable for use as a LAN server or multiuser system host, but it would take up too much space to fit comfortably on most desks.

SEPTEMBER 1988 81

TABLE 3: Benchmark Results

| EQUIPMENT  ROM BIOS date  80386 processor speed (MHz)  80387 coprocessor speed (MHz)  Base memory size (MB)  Memory cache size (KB)  Video controller  Hard-disk size (MB)  HITEXT (text scrolling)  BIOS  DOS  C library  Windowed  1.75  Total  14.78  HLWINDOW (window/scrolling)  Total  2.80  HLGRAPH (16-color graphics)  400 small areas  100 large areas  400 small ellipses  2.00 large ellipses  4,000 short lines  2.41  2,000 long lines  General graphs  Total  17.08  HLSORT (CPU/memory)  Data generation  Memory sort  Total  7.74  HLFLOAT (Fast Fourier Transform)  Forward  Reverse  3.24  Total  HLDISK (with disk cache) <sup>b</sup> Data file creation  2.96  | 25<br>25<br>2<br>64   | 25<br>25<br>1<br>32   | 25<br>25<br>1<br>64 <sup>a</sup>   | 25<br>25<br>2<br>64  |
|--|---|---|--|--|
| ROM BIOS date 09/23/8 80386 processor speed (MHz) 20 80387 coprocessor speed (MHz) 20 Base memory size (MB) 1 Memory cache size (KB) 32 Video controller 16-bit Hard-disk size (MB) 300  HITEXT (text scrolling) BIOS 3.95 DOS 4.94 C library 4.12 Windowed 1.75 Total 14.78  HLWINDOW (window/scrolling) Total 2.80  HIGRAPH (16-color graphics) 400 small areas 3.68 100 large areas 2.58 400 small ellipses 2.91 200 large ellipses 2.69 4,000 short lines 2.41 2,000 long lines 2.19 General graphs 0.60 Total 17.08  HISORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74  HIFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48  HLDISK (with disk cache) <sup>b</sup>   | 25<br>264<br>VGA 16-bit V<br>150<br>6.37<br>8.51<br>7.08<br>2.63<br>24.61<br>4.34<br>3.29<br>2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54     | 25<br>25<br>1<br>32<br>VGA 16-bit V<br>110<br>3.68<br>4.39<br>3.79<br>1.53<br>13.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54   | 25<br>25<br>1<br>64 <sup>a</sup><br>VGA 8-bit EG<br>130<br>13.07<br>13.95<br>13.95<br>7.19<br>48.18<br>10.54<br>2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49 | 25<br>25<br>264<br>64 8-bit VGA<br>120<br>9.06<br>10.16<br>9.78<br>2.96<br>31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60 |
| 80386 processor speed (MHz)       20         80387 coprocessor speed (MHz)       20         Base memory size (MB)       1         Memory cache size (KB)       32         Video controller       16-bit         Hard-disk size (MB)       300         HITEXT (text scrolling)         BIOS       3.95         DOS       4.94         C library       4.12         Windowed       1.75         Total       14.78         HLWINDOW (window/scrolling)       1.478         HLGRAPH (16-color graphics)       400 small areas       3.68         100 large areas       2.58         400 small ellipses       2.91         200 large ellipses       2.69         4,000 short lines       2.41         2,000 long lines       2.19         General graphs       0.60         Total       17.08         HLSORT (CPU/memory)       Data generation       0.65         Memory sort       7.08         Total       7.74         HLFLOAT (Fast Fourier Transform)       Forward       3.24         Reverse       3.24         Total       6.48  | 25<br>2<br>64<br>VGA 16-bit V<br>150<br>6.37<br>8.51<br>7.08<br>2.63<br>24.61<br>4.34<br>3.29<br>2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54 | 25<br>1<br>32<br>VGA 16-bit V<br>110<br>3.68<br>4.39<br>3.79<br>1.53<br>13.40<br>2.41<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54 | 25<br>1<br>64 <sup>a</sup><br>8-bit EG<br>130<br>13.07<br>13.95<br>13.95<br>7.19<br>48.18<br>10.54<br>2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49           | 25<br>2<br>64<br>8-bit VGA<br>120<br>9.06<br>10.16<br>9.78<br>2.96<br>31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60      |
| 80387 coprocessor speed (MHz)       20         Base memory size (MB)       1         Memory cache size (KB)       32         Video controller       16-bit         Hard-disk size (MB)       300         HITEXT (text scrolling)       300         BIOS       3.95         DOS       4.94         C library       4.12         Windowed       1.75         Total       14.78         HLWINDOW (window/scrolling)       3.68         HOUS small areas       3.68         100 large areas       2.58         400 small ellipses       2.91         200 large ellipses       2.69         4,000 short lines       2.41         2,000 long lines       2.19         General graphs       0.60         Total       17.08         HLSORT (CPU/memory)       0.65         Data generation       0.65         Memory sort       7.08         Total       7.74         HLFLOAT (Fast Fourier Transform)       Forward       3.24         Reverse       3.24         Total       6.48  | 2<br>64<br>VGA 16-bit V<br>150<br>6.37<br>8.51<br>7.08<br>2.63<br>24.61<br>4.34<br>3.29<br>2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54       | 1<br>32<br>VGA 16-bit V<br>110<br>3.68<br>4.39<br>3.79<br>1.53<br>13.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54               | 1 64 <sup>a</sup> 8-bit EG 130  13.07 13.95 13.95 7.19 48.18  10.54  2.47 1.70 2.52 2.47 2.08 1.92 0.49  | 2<br>64<br>8-bit VGA<br>120<br>9.06<br>10.16<br>9.78<br>2.96<br>31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60            |
| Base memory size (MB)  Memory cache size (KB)  Video controller  Hard-disk size (MB)  BIOS  BIOS  DOS  C library  Windowed  Total  HLWINDOW (window/scrolling)  Total  LGRAPH (16-color graphics)  400 small areas  100 large areas  400 small ellipses  2.91  200 large ellipses  4,000 short lines  2,000 long lines  General graphs  Total  HLSORT (CPU/memory)  Data generation  Memory sort  Total  Total  HLFLOAT (Fast Fourier Transform)  Forward  Reverse  3.24  Total  HLDISK (with disk cache)  Jood  16-bit  32  32  16-bit  32  4.94  4.94  4.94  4.12  4.1 | 64 VGA 16-bit V 150  6.37 8.51 7.08 2.63 24.61  4.34  3.29 2.36 2.58 2.41 2.41 2.19 0.54  | 32<br>16-bit V<br>110<br>3.68<br>4.39<br>3.79<br>1.53<br>13.40<br>2.41<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54                | 64 <sup>a</sup> 8-bit EG 130  13.07 13.95 13.95 7.19 48.18  10.54  2.47 1.70 2.52 2.47 2.08 1.92 0.49  | 9.06<br>10.16<br>9.78<br>2.96<br>31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60   |
| Video controller       16-bit         Hard-disk size (MB)       300         HITEXT (text scrolling)       300         BIOS       3.95         DOS       4.94         C library       4.12         Windowed       1.75         Total       14.78         HLWINDOW (window/scrolling)       10         Total       2.80         HLGRAPH (16-color graphics)       3.68         400 small areas       3.68         100 large areas       2.58         400 small ellipses       2.91         200 large ellipses       2.69         4,000 short lines       2.41         2,000 long lines       2.19         General graphs       0.60         Total       17.08         HLSORT (CPU/memory)       0.65         Data generation       0.65         Memory sort       7.08         Total       7.74         HLFLOAT (Fast Fourier Transform)       Forward       3.24         Reverse       3.24         Total       6.48  | VGA 16-bit V<br>150  6.37 8.51 7.08 2.63 24.61  4.34  3.29 2.36 2.58 2.41 2.41 2.19 0.54  | 3.68<br>4.39<br>3.79<br>1.53<br>13.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54   | 13.07<br>13.07<br>13.95<br>13.95<br>7.19<br>48.18<br>10.54<br>2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49   | 9.06<br>10.16<br>9.78<br>2.96<br>31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60   |
| Hard-disk size (MB) 300  HITEXT (text scrolling)  BIOS 3.95  DOS 4.94  C library 4.12 Windowed 1.75  Total 14.78  HIWINDOW (window/scrolling)  Fotal 2.80  HIGRAPH (16-color graphics)  400 small areas 3.68 100 large areas 2.58 400 small ellipses 2.91 200 large ellipses 2.69 4,000 short lines 2.41 2,000 long lines 2.19 General graphs 0.60  Total 17.08  HISORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74  HIFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24  Total 6.48  HILDISK (with disk cache)   | 3.29<br>2.36<br>2.58<br>2.41<br>2.19<br>0.54  | 3.68<br>4.39<br>3.79<br>1.53<br>13.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54   | 130<br>13.07<br>13.95<br>13.95<br>7.19<br>48.18<br>10.54<br>2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49   | 9.06<br>10.16<br>9.78<br>2.96<br>31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60   |
| ######################################   | 6.37<br>8.51<br>7.08<br>2.63<br>24.61<br>4.34<br>3.29<br>2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54   | 3.68<br>4.39<br>3.79<br>1.53<br>13.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54   | 13.07<br>13.95<br>13.95<br>7.19<br>48.18<br>10.54<br>2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49  | 9.06<br>10.16<br>9.78<br>2.96<br>31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60   |
| BIOS 3.95 DOS 4.94 C library 4.12 Windowed 1.75 Total 14.78 HLWINDOW (window/scrolling) Fotal 2.80 HLGRAPH (16-color graphics) 400 small areas 3.68 100 large areas 2.58 400 small ellipses 2.91 200 large ellipses 2.69 4,000 short lines 2.41 2,000 long lines 2.19 General graphs 0.60 Total 17.08 HLSORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74 HLFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48 HLDISK (with disk cache) <sup>b</sup>   | 8.51<br>7.08<br>2.63<br>24.61<br>4.34<br>3.29<br>2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54   | 4.39<br>3.79<br>1.53<br>13.40<br>2.41<br>3.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54   | 13.95<br>13.95<br>7.19<br>48.18<br>10.54<br>2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49   | 10.16<br>9.78<br>2.96<br>31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60   |
| BIOS 3.95 DOS 4.94 C library 4.12 Windowed 1.75 Total 14.78 HLWINDOW (window/scrolling) Fotal 2.80 HLGRAPH (16-color graphics) 400 small areas 3.68 100 large areas 2.58 400 small ellipses 2.91 200 large ellipses 2.69 4,000 short lines 2.41 2,000 long lines 2.19 General graphs 0.60 Total 17.08 HLSORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74 HLFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48 HLDISK (with disk cache) <sup>b</sup>   | 8.51<br>7.08<br>2.63<br>24.61<br>4.34<br>3.29<br>2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54   | 4.39<br>3.79<br>1.53<br>13.40<br>2.41<br>3.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54   | 13.95<br>13.95<br>7.19<br>48.18<br>10.54<br>2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49   | 10.16<br>9.78<br>2.96<br>31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60   |
| C library 4.12 Windowed 1.75 Total 14.78  HLWINDOW (window/scrolling) Total 2.80  HLGRAPH (16-color graphics) 400 small areas 3.68 100 large areas 2.58 400 small ellipses 2.91 200 large ellipses 2.69 4,000 short lines 2.41 2,000 long lines 2.19 General graphs 0.60 Total 17.08  HLSORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74  HLFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48  HLDISK (with disk cache) <sup>b</sup>   | 7.08<br>2.63<br>24.61<br>4.34<br>3.29<br>2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54   | 3.79<br>1.53<br>13.40<br>2.41<br>3.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54   | 13.95<br>7.19<br>48.18<br>10.54<br>2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49  | 9.78<br>2.96<br>31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60  |
| Windowed 1.75  Total 14.78  HLWINDOW (window/scrolling)  Fotal 2.80  HLGRAPH (16-color graphics)  400 small areas 3.68 100 large areas 2.58 400 small ellipses 2.91 200 large ellipses 2.69 4,000 short lines 2.41 2,000 long lines 2.19 General graphs 0.60 Total 17.08  HLSORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74  HLFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48  HLDISK (with disk cache) <sup>b</sup>   | 2.63<br>24.61<br>4.34<br>3.29<br>2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54   | 1.53<br>13.40<br>2.41<br>3.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54   | 7.19 48.18  10.54  2.47 1.70 2.52 2.47 2.08 1.92 0.49  | 2.96<br>31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60  |
| Windowed         1.75           Total         14.78           HLWINDOW (window/scrolling)         2.80           HLGRAPH (16-color graphics)         4400 small areas         3.68           100 large areas         2.58           400 small ellipses         2.91           200 large ellipses         2.69           4,000 short lines         2.19           2,000 long lines         2.19           General graphs         0.60           Total         17.08           HLSORT (CPU/memory)         0.65           Memory sort         7.08           Total         7.74           HLFLOAT (Fast Fourier Transform)         Forward           Reverse         3.24           Total         6.48           HLDISK (with disk cache) <sup>b</sup>   | 24.61 4.34 3.29 2.36 2.58 2.41 2.41 2.19 0.54   | 13.40<br>2.41<br>3.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54   | 2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49   | 31.97<br>5.43<br>3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60  |
| Total   14.78  | 4.34<br>3.29<br>2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54  | 2.41 3.40 2.41 2.41 2.25 2.03 1.86 0.54   | 2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49   | 5.43  3.68 3.02 2.80 2.63 2.74 2.63 0.60   |
| ######################################   | 3.29<br>2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54  | 3.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54  | 2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49   | 3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60   |
| ######################################   | 3.29<br>2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54  | 3.40<br>2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54  | 2.47<br>1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49   | 3.68<br>3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60   |
| 400 small areas 3.68 100 large areas 2.58 400 small ellipses 2.91 200 large ellipses 2.69 4,000 short lines 2.41 2,000 long lines 2.19 General graphs 0.60 Total 17.08  HLSORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74  HLFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48  HLDISK (with disk cache) <sup>b</sup>   | 2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54  | 2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54  | 1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49   | 3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60   |
| 400 small areas 3.68 100 large areas 2.58 400 small ellipses 2.91 200 large ellipses 2.69 4,000 short lines 2.41 2,000 long lines 2.19 General graphs 0.60 Total 17.08  HLSORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74  HLFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48  HLDISK (with disk cache) <sup>b</sup>   | 2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54  | 2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54  | 1.70<br>2.52<br>2.47<br>2.08<br>1.92<br>0.49   | 3.02<br>2.80<br>2.63<br>2.74<br>2.63<br>0.60   |
| 100 large areas       2.58         400 small ellipses       2.91         200 large ellipses       2.69         4,000 short lines       2.41         2,000 long lines       2.19         General graphs       0.60         Total       17.08         HLSORT (CPU/memory)         Data generation       0.65         Memory sort       7.08         Total       7.74         HLFLOAT (Fast Fourier Transform)       Forward         Reverse       3.24         Total       6.48         HLDISK (with disk cache) <sup>b</sup>  | 2.36<br>2.58<br>2.41<br>2.41<br>2.19<br>0.54  | 2.41<br>2.41<br>2.25<br>2.03<br>1.86<br>0.54  | 2.52<br>2.47<br>2.08<br>1.92<br>0.49   | 2.80<br>2.63<br>2.74<br>2.63<br>0.60   |
| 400 small ellipses 2.91 200 large ellipses 2.69 4,000 short lines 2.41 2,000 long lines 2.19 General graphs 0.60 Total 17.08  HLSORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74  HLFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48  HLDISK (with disk cache) <sup>b</sup>   | 2.58<br>2.41<br>2.41<br>2.19<br>0.54  | 2.25<br>2.03<br>1.86<br>0.54  | 2.47<br>2.08<br>1.92<br>0.49   | 2.63<br>2.74<br>2.63<br>0.60   |
| 2000 large ellipses 2.69 4,000 short lines 2.41 2,000 long lines 2.19 General graphs 0.60 Total 17.08  HLSORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74  HLFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48  HLDISK (with disk cache) <sup>b</sup>  | 2.41<br>2.41<br>2.19<br>0.54  | 2.03<br>1.86<br><u>0.54</u>   | 2.47<br>2.08<br>1.92<br>0.49   | 2.74<br>2.63<br>0.60   |
| 4,000 short lines 2.41 2,000 long lines 2.19 General graphs 0.60 Total 17.08  HISORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74  HIFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48  HILDISK (with disk cache) <sup>b</sup>  | 2.41<br>2.19<br>0.54  | 2.03<br>1.86<br><u>0.54</u>   | 1.92<br><u>0.49</u>  | 2.74<br>2.63<br>0.60   |
| 2,000 long lines       2.19         General graphs       0.60         Total       17.08         HLSORT (CPU/memory)       0.65         Data generation       0.65         Memory sort       7.08         Total       7.74         HLFLOAT (Fast Fourier Transform)       Forward         Reverse       3.24         Total       6.48         HLDISK (with disk cache) <sup>b</sup>   | 2.19<br>0.54  | 1.86<br><u>0.54</u>   | 1.92<br><u>0.49</u>  | 2.63<br>   |
| General graphs         0.60           Total         17.08           HLSORT (CPU/memory)         0.65           Data generation         0.65           Memory sort         7.08           Total         7.74           HLFLOAT (Fast Fourier Transform)         Forward           Reverse         3.24           Total         6.48           HLDISK (with disk cache) <sup>b</sup>   | 0.54  | 0.54  | 0.49   | 0.60   |
| Total 17.08  HISORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74  HIFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48  HILDISK (with disk cache) <sup>b</sup>   |   |   |  |  |
| HLSORT (CPU/memory) Data generation 0.65 Memory sort 7.08 Total 7.74  HLFLOAT (Fast Fourier Transform) Forward 3.24 Reverse 3.24 Total 6.48  HLDISK (with disk cache) <sup>b</sup>   |   |   |  |  |
| Data generation $0.65$ Memory sort $7.08$ Total $7.74$ HLFLOAT (Fast Fourier Transform) Forward $3.24$ Reverse $3.24$ Total $6.48$ HLDISK (with disk cache) <sup>b</sup>   |   |   |  |  |
| Memory sort $\frac{7.08}{7.74}$ Total $\frac{7.74}{7.74}$ HLFLOAT (Fast Fourier Transform)  Forward $\frac{3.24}{8.24}$ Reverse $\frac{3.24}{6.48}$ HLDISK (with disk cache) <sup>b</sup>  | 0.49  | 0.54  | 0.49   | 0.49   |
| Total 7.74 <b>HLFLOAT</b> (Fast Fourier Transform)  Forward 3.24  Reverse 3.24  Total 6.48 <b>HLDISK</b> (with disk cache) $^b$  | 5.38  | 5.71  | 5.38   | 5.60   |
| HLFLOAT (Fast Fourier Transform)Forward $3.24$ Reverse $3.24$ Total $6.48$ HLDISK (with disk cache) $^b$   | 5.87  | 6.26  | 5.87   | 6.09   |
| Forward $3.24$ Reverse $3.24$ Total $6.48$ HLDISK (with disk cache) <sup>b</sup>   |   |   |  |  |
| Reverse $\frac{3.24}{6.48}$ Total $6.48$ HLDISK (with disk cache) <sup>b</sup>   | 2.50  | 250   | 250  | 2.58   |
| Total 6.48 <b>HLDISK</b> (with disk cache) <sup>b</sup>  | 2.58  | 2.58  | 2.58   |  |
| <b>HLDISK</b> (with disk cache) <sup>b</sup>   | 2.52  | 2.63  | 2.63   | 2.63   |
|  | 5.10  | 5.21  | 5.21   | 5.21   |
| Data file creation 2.06  | PSA-0T labour S   |   | ou work and in   |  |
|  | 2.96  | 2.91  | 3.07   | 3.02   |
| ndex file creation 15.71   | 13.51   | 13.68   | 15.60  | 15.32  |
| First report generation 1.26   | 0.76  | 1.20  | 0.93   | 0.87   |
| Data reorganization 3.46   | 3.35  | 3.46  | 3.62   | 3.79   |
| Second report generation $0.76$  | 0.49  | 0.65  | 0.82   | 1.15   |
| Total 24.12  | 21.51   | 21.97   | 24.17  | 24.23  |
| HLDISK (without disk cache)  |   |   |  |  |
| Data file creation 2.96  | 2.96  | 2.91  | 3.02   | 2.96   |
| Index file creation 22.58  | 19.72   | 20.38   | 20.27  | 26.86  |
| First report generation 5.98   | 6.31  | 5.82  | 2.30   | 11.31  |
| Data reorganization 9.72   |   | 8.46  | 4.61   | 15.93  |
| Second report generation 0.76  | 9.78  | 0.76  | 0.93   | 3.29   |
| Total 42.08  | 9.78<br>0.76  | 0.70  |  | 60.43  |

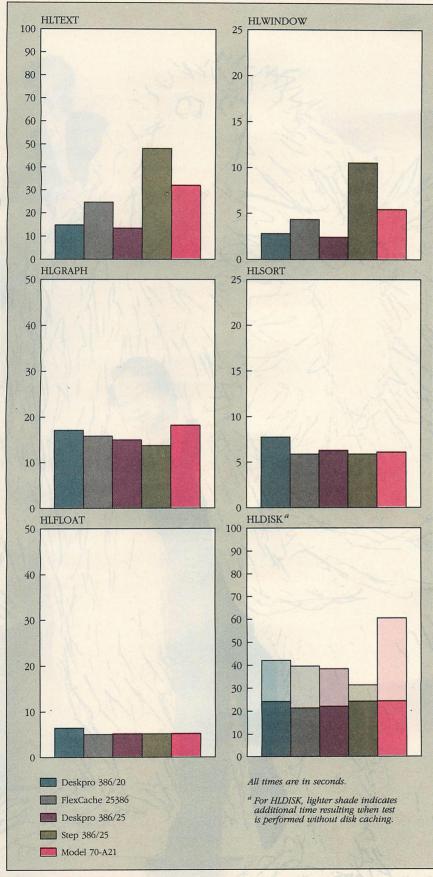
All four systems offer CPU/memory and computational performance 20 to 25 percent faster than that of the Deskpro 386/20. Disk caching makes the performance of all four systems very similar, and not all that different from the Deskpro 386/20.

All times are in seconds.

<sup>a</sup> The STEP 386/25 features 64KB, 128KB, or 256KB of cache memory depending on the amount of system memory.

<sup>b</sup> The 256KB extended memory disk cache was implemented using vendor-provided software.

# FIGURE 1: Performance Comparison



With its 16-bit VGA, the Compaq Deskpro 386/25 provides by far the best video performance. The Everex Step 386/25, with its EGA, provides the slowest.

The IBM Model 70-A21 is a small, powerful desktop computer. It offers the best capacity and performance per cubic inch of all the systems reviewed. Its performance is comparable to that of the other three, which is unusual considering that IBM does not have a reputation for building high-performance computers. Its three Micro Channel expansion slots should be sufficient for everyone except the power user who needs more than 8MB of memory and wants high-resolution video, network, and mainframe-communications boards. IBM's machine has limited hard-disk storage, supporting only one 120MB hard disk. One of the other systems reviewed here or the floor-standing 20-MHz PS/2 Model 80-311 might be a better alternative for applications requiring large amounts of mass storage.

All four of these machines are extremely good performers, and none of them is inexpensive. But if a 25-MHz system is required to get the job done, these systems are up to the task. For those who can stand to poke along at 20-MHz, all four vendors offer comparable, less-expensive systems that operate at that speed.

Advanced Logic Research Inc. 9401 Jeronimo Irvine, CA 92718 714/581-6770 FlexCache 25386 CIRCLE 341 ON READER SERVICE CARD

Compaq Computer Corporation

20555 FM 149 Houston, TX 77070 713/370-0670 Deskpro 386/25

CIRCLE 342 ON READER SERVICE CARD

Everex 48431 Milmont Drive Fremont, CA 94538 800/821-0806; for nearest reseller, 800/356-4283 Step 386/25

CIRCLE 343 ON READER SERVICE CARD

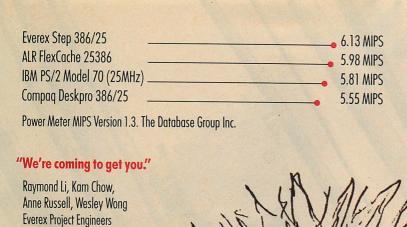
IBM Corporation 900 King Street Rye Brook, NY 10573 800/426-2468; for nearest dealer, 800/447-4700 PS/2 Model 70-A21 CIRCLE 344 ON READER SERVICE CARD

David Claiborne is a technical manager for JAYCOR in Edgewood, Maryland. Jim Shields is the senior technical editor for

PC Tech Journal.

SEPTEMBER 1988 83







"If you're afraid of monsters, please turn the page."

What makes our new computer unnervingly fast can be explained in three words: write back cache.

Simply put, it means less work: you don't write to the main memory every time you write to the cache.

It's an approach to memory management found only on mainframes and on Everex Step computers.

And in a world where a 32k cache is the norm, ours expands to 256k.

The Step 386. It's a monster of a machine.

Find out more about Step 386 and Step 286 computers. Call 1-800-356-4283. Everex Computer Systems Division, 48431 Milmont Drive, Fremont, CA 94538.





# A New Twist for Ethernet

Running a network over twisted-pair telephone wire sounds like a dream come true for those caught in the middle of a cabling nightmare. Products from SynOptics and 3Com lead the way.

JOHN KOLMAN

hat if the most popular local area network (LAN) hardware protocol in the personal computer environment—Ethernet—could effectively team up with the most abundant installed cable in American business—telephone wire? The Institute of Electrical and Electronics Engineers (IEEE) earlier this year initiated a standard for Ethernet on twisted-pair telephone cable at 10 megabits per second (Mbps), turning this tale into reality.

As IEEE works on finalizing its standard, many products are already on the market that implement Ethernet on twisted-pair wire at 10 Mbps. LattisNet from SynOptics Communications (formerly Astra Communications) and the MultiConnect from 3Com Corporation lead the pack and represent the two primary approaches now being taken by vendors.

While Ethernet previously could dawdle along at only 1 Mbps on twisted-pair wire, the IEEE-sanctioned and vendor-supported 10 Mbps scheme is likely to be a boon to computerized networking in mainstream business. It can reduce wiring and installation costs, ease maintenance, and expand the total LAN market.

Wiring is typically the greatest expense and complexity in installing a LAN because competing systems traditionally support differing wire types (such as terminals on RG-62 coaxial or twinaxial cable and Ethernet on RG-58 or RG-11 coax), and a departmental move or computer system change almost always involves rewiring.

A universal cable accommodating many vendors' systems and different end-user configurations—including all major IEEE LAN network protocols at standard speeds as well as terminals for major centralized systems, such as IBM S/370, IBM S/3x, DEC VAX, and Wang could negate the need for constant rewiring. Using preexisting twisted-pair telephone wires also can reduce initial wiring costs and headaches. A universal connection to every desk or office means that LAN managers can relocate devices (such as workstations, servers, and terminals) and reconfigure networks more easily at wire concentration points rather than at desktops.

The design of organized telephone twisted-pair distribution systems makes them readily adaptable for adding data transmission capabilities. These voice transmission systems often have spare



# Introducing WordPerfect Office: Because your LAN should link people, too.

Your LAN connects your computers and the work they handle. But shouldn't it connect people, too?

Introducing WordPerfect Office. Designed to improve group communications and productivity by enhancing the powers of your LAN.

Take WP Office's Electronic mail, for instance. It delivers and sends messages; it also keeps each LAN user informed of the status of those messages, both incoming and outgoing.

And with a few simple keystrokes, anyone on the LAN can set up a meeting with WP Office's Scheduler feature. Just plug in the amount of

meeting time required, the range of hours preferred, and the names of those who should attend. WP Office then finds the first available time slot and notifies the appropriate people by electronic mail.

Other useful features include a simple database program, calendar, calculator, file manager, macro and program editor, and access to all programs on the LAN.

WordPerfect Office is the network productivity system that can bring out the best in your LAN and the people who work on it. For more information, call or write WordPerfect Corporation, 1555 North Technology Way, Orem, Utah 84057, (801) 225-5000\*

# WordPerfect Office

## A NEW TWIST FOR ETHERNET

wire pairs running to each office, especially where private branch exchange (PBX) systems have been installed.

In such a system, station wire runs from office or workstation area, usually directly, to a wiring distribution center or wiring closet. Each wiring closet serves a local cluster of workstations typically within 150 feet. Closets contain interconnection hardware—wiring blocks-that link the station wire to the building's backbone wire (called the riser system). Wires are punched down or seated on the wiring block with a special tool to ensure a good connection; the location is called a punchdown block. Horizontal-riser runs connect wiring closets on the same floor, while vertical runs connect closets on different floors. A closet on the lowest floor is often the main wiring closet or main distribution frame (MDF), where cables from outside the building connect to the system.

Because this well-organized wiring system exists in nearly every building, the idea of using excess wire to carry LAN traffic is a natural. The challenge has been to find technology that allows high-speed digital data to be carried on wires meant for analog telephone calls.

### THE FACE OF CLASSIC ETHERNET

More than 100 vendors sell or support Ethernet networks for PCs, minicomputers, scientific workstations, and large mainframes. It is one of the most widely implemented network protocols.

In the IEEE 802.3 standard, several devices share one data path in Ethernet's bus topology, each one managing access to the network so that the bandwidth is shared. Conflicts arise when more than one device tries to transmit at the same time on shared cable.

To manage such conflicts, Ethernet defines an error detection and recovery protocol known as CSMA/CD for carrier sense, multiple access/collision detect (see "LAN Hardware Standards," Art Krumrey and John Kolman, June 1987, p. 54). Carrier sense means a network device checks that the media are not in use before the device transmits. Multiple access means that, as soon as the media are found available, the device can begin transmitting. Collision detect means the transmitting device listens for a collision (the overlap of two or more network transmissions).

When it detects a collision, the device stops transmission and waits for a random amount of time before attempting retransmission. These individual random waits reduce the possibility that the same devices will collide upon

retransmission. Network response time depends on network traffic. This differs from the token-passing ring where each station has uniform access to the media, limiting the amount of time a station will wait before transmitting.

The architecture of the collision-detect mechanism limits the linear span of Ethernet networks. Because collision noise has to propagate back to the sending device, the worst-case collision is one between the two devices most distant from each other. *Propagation delay* is the time a signal takes to travel from one point to another. Data signals propagate through coaxial Ethernet cable at a speed of 0.77c (c is the velocity of light, about 300,000 kilometers per second). The IEEE 802.3 standard

The design of telephone twisted-pair distribution systems makes them readily adaptable for adding data transmission capabilities.

defines the maximum propagation delay for an Ethernet network as 25.6 microseconds ( $\mu$ s). Thus, the maximum size of an Ethernet network must be such that the round-trip signal propagation time is 51.2  $\mu$ s or less.

Actual distance relating to the 51.2- $\mu$ s limit depends on cabling and type of transmissions. Classic Ethernet uses one or more segments of coax arranged in a bus topology; the segment cable connects each network device with a T-connector and only one path traverses the network.

Ethernet can use either broadband or baseband signaling, but generally uses baseband. Broadband uses radio frequencies to transmit data streams. Such networks use frequency division multiplexing (FDM), much like cable television, where separate frequency channels on cable can operate separate networks or carry voice and video traffic. The primary disadvantage of broadband networks is cost because they require special transceivers (transmitter/receiver interfaces from the network to the device) to create radio frequencies for data transmission.

Baseband networks use two different coax types: thin-wire (RG-58) for segments of less than 330 meters and thick-wire (RG-11) for backbone seg-

ments up to 500 meters. (A meter is about 3.3 feet.) Installations can, and usually do, combine both types. Repeaters and fiber-optic cable increase distances. Distances of up to 2,800 meters using thick-wire coax with repeaters and up to 4,000 meters using fiber cable can stay within the 51.2  $\mu$ s propagation-delay constraint.

The IEEE 802.3-1985 document's 10Base5 specification is IEEE's designation for a 10-Mbps baseband implementation of CSMA/CD Ethernet networks over a medium whose maximum segment length is 500 meters. A second specification, 10Base2, defines the lower-cost thin-wire implementation. CSMA/CD can operate at other signal rates over different media such as twisted-pair telephone wire. In theory, very high data speeds could be supported on almost any media, although distance may be severely limited.

Conversely, reducing data-transmission speed allows longer cable lengths. StarLAN is a 1-Mbps CSMA/CD system defined by the 1Base5 specification of IEEE 802.3. It operates over twisted-pair wire at distances up to 245 meters and is designed for smaller networks where the disadvantage of slower speed is offset by the ease of wiring.

Classic Ethernet lends itself to a decentralized wiring approach. Thinwire implementations daisy-chain the coaxial cable through a T-connector on the back of the station's adapter card; thick-wire implementations use a short drop cable to connect the station to the main cable. Although each segment in the network must be a linear bus, the network can be extended to a tree topology from virtually any point by using a repeater. This allows a flexible but undisciplined physical plant design that usually decreases initial wiring costs but increases administration and upgrade costs. Network faults—failures in medium (cable), attachment unit interface (AUI), or a network interconnect component (such as bridges and repeaters)—can be hard to diagnose.

### **RACING TO THE WIRE**

The trend is away from coax as a universal media—no one coax type can support all available data communications protocols. Although it has a high bandwidth, good noise resistance, and a large carrying distance, coax cannot support voice communication and is more difficult to install and terminate.

Further, protocols supporting coax have not standardized the coax type—IBM S/3x uses twinax, IBM 3270 terminals use RG-62, and Ethernet uses

# THE LIGHTNING WAY TO "C"

PRO-C. The first complete 'C' application tool that produces 'C' code. Programming can now be easier and routine coding problems are now eliminated. The **only** source code generator that runs on MSDOS, QNX, XENIX and UNIX, PRO-C has the ability to reproduce the normal functions of complex application software.

# DATA DEFINITION

Utilizing the integrated PRO-C generators to create menu, screen and report programs or batch processes.

# INTEGRATED GENERATORS

Screens Menus Reports Batch processes. Combined they can generate any business or database application.

# **● CONTEXT – SENSITIVE HELP**

Complete context sensitive help is available at the touch of the help key.

# • UTILITIES

Professional utilities allow the selection of your development environment, on line help for generated programs and full program documentation.

Call today for more information. Toll free 1-800-265-8887 North America Only.

Chancelogic Inc.

Allen Square, 180 King St. South, Waterloo, Ontario, Canada N2J 1P8.

Tel: 519-745-2700.

Fax: 519-746-1613.

PRO-C — CHANCELOGIC INC. XENIX and MSDOS — Microsoft Corp. QNX — Quantum Software Systems Ltd. UNIX — AT&T Bell Laboratories.

CIRCLE NO. 206 ON READER SERVICE CARD

# A NEW TWIST FOR ETHERNET

RG-58 or RG-11. Size is also a problem; the diameter of coax can overload a building's distribution system, especially where building codes require installation in conduit. For example, a bundle of only 25 RG-62 coaxial cables is more than six inches in diameter.

Fiber-optic cable has certain advantages over twisted pair: it is immune to electrical or magnetic influence, is difficult to tap, does not radiate energy, and has a very high bandwidth. But, fiber-optic cable is more expensive, difficult to terminate, and harder to install, generally prohibiting its use as station wire. It is an excellent choice for network backbone cabling where higher installation costs are offset by the high bandwidth.

Twisted-pair wire, on the other hand, is the primary contender for title of universal wiring system for data and voice communications. It is inexpensive, easy to install and terminate, and prevalent in most buildings. It also has the advantage of broad multivendor support—available products include those connecting IBM 3270s, S/3x terminals, Wang workstations, DEC terminals, Ethernet, and Token-Ring.

Twisted pair's much smaller bandwidth, its susceptibility to electromagnetic interference (EMI), and its energy radiation are disadvantages. Improvements in technology have pushed twisted-pair data rates to 1 Mbps for StarLAN, then to 4 Mbps for Token-Ring, and now to 10 Mbps for Ethernet.

IBM, DEC, and AT&T each have published specifications for universal wiring systems that can connect many different workstations and telephones. AT&T's and IBM's plans are based on twisted-pair station wiring with a fiberoptic backbone. DEC's plan differs in that both twisted pair and coax run to each desktop.

Ironically, universality can sometimes be the downfall of twisted-pair cabling systems. They can get out of control easily, creating a spaghetti-like topology, duplication of efforts, or even loss of service. A comprehensive wiremanagement policy helps allocate wire-pair usage throughout a system to avoid such disasters. Companies that offer software-based wire-management systems include Communications Design Corporation, MosCom, MCS Inc., Commercial Software Inc., and Architecture Technologies.

### LEARNING TO TWIST

Twisted-pair wiring comes in different gauges (diameter of the conductor), bundle size, jacket materials, and shielding configurations. Gauges commonly used for telecommunications applications range from American Wire Gauge (AWG) 18 to AWG 30, specifying wire with outside diameters of 0.0403 to 0.0100 inches. Cable bundles have at least two wire pairs surrounded by an outer jacket. Most wiring has a minimum of three pairs in anticipation that the extra pair eventually will be used. Only a small cost difference separates two-pair (four-conductor) and three-pair (six-conductor) cable.

Twisted-pair jackets can be made of flame-resistant materials, such as Teflon, that do not emit toxic fumes when burned. This is important when cable is run through the air-circulation system. In buildings where suspended

The challenge has been to find technology that allows high-speed digital data to be carried on wires meant for analog telephone calls.

ceiling is used as an air return, building codes may require all cable to be made of fire-safe materials. Jackets also can be made waterproof (for direct-buried cable installations), or self-supporting, moisture-proof, and resistant to damage by the elements (for aerial cable installations). Twisted pair can be unshielded or shielded in a metal sheath around a single twisted pair or a complete bundle.

As with any LAN cabling, the decision of what type of twisted-pair wire to use in a network depends mainly on the distance, transmission speed, and signal quality of the network. LAN integrators need to consider resistance, impedance, attenuation, and velocity of signal propagation.

Resistance, which can be measured with an ohmmeter, is the opposition to flow of direct current (DC). Wire characteristics that affect its resistance are run length, gauge (diameter), material, and operating temperature. The longer the wire, the more opposition; the thicker it is, the less resistance. Normal telephone cable uses 24-gauge copper wire, which has a resistance of 18.8 ohms per 100 meters. In material choice, silver has the lowest resistance, followed by copper (which is most often used in communication wire),

gold, and aluminum. Finally, rising temperature increases resistance approximately 0.3 percent per degree Celsius, but this is rarely a problem in climate-controlled office environments.

Impedance measures opposition to the flow of an alternating current (AC). Different cable types have different characteristic impedances, which are measured at the normal operating frequency of the signal transmitted on the cable. Ethernet coax has a 50-ohm characteristic impedance, shielded twisted pair (IBM Type 1) has a 150ohm characteristic impedance, and most unshielded twisted-pair wire has between 70 and 150 ohms characteristic impedance (usually about 100 ohms). SynOptics' design provides two separate devices: an unshielded unit, supporting 100 ohms ±15 percent, and a shielded unit, supporting 150-ohm wiring. 3Com supports characteristic impedances from 70 to 150 ohms.

Attenuation is the ratio of input signal to output signal expressed in decibels (dB) per unit of length, and varies at different frequencies. It measures loss of signal strength over distance through impedance. The IEEE 802.3 Ethernet allows a signal loss of 1.7 dB over 100 meters of coaxial cable, while Ethernet over twisted-pair products lose up to 10 dB over the same distance. Attenuation has been a major technical obstacle to the transmission of high-frequency data over twisted-pair wire.

Velocity of propagation expressed as a percentage of the speed of light (c) is the speed at which a signal travels through a transmission medium. Velocity is important in calculating the total Ethernet network delay budget. Twisted pair propagates signals more slowly, at 0.66c as opposed to 0.77c for coax. This factor taken alone indicates that the maximum distance of twistedpair implementations must be at least 15 percent shorter than coax to stay within Ethernet's 51.2-μs propagation delay constraint.

### THE NOISE FACTOR

The suitability of any cable for an application depends on how much it impedes or delays transmitted signals. Twisted-pair wire is extremely susceptible to noise, unwanted electrical signals introduced into the transmission media that can distort data signals and cause them to arrive in a slightly different form than they were sent. Noise may be introduced by transmission equipment or the environment, the latter becoming more predominate as the

SEPTEMBER 1988 91

# A NEW TWIST FOR ETHERNET

length of unshielded wire increases. Sources of environmental noises include power cables, fluorescent lighting, copier machines, and natural occurrences such as electrical storms.

Ethernet receivers are engineered to adjust for some noise. Because more powerful signals are less likely to be washed out by noise, the noise is usually measured by the ratio of the power in the signal (S) to the power of the noise (N). The signal-to-noise ratio (S/N) usually is expressed in decibels. The higher the S/N, the better the signal quality. Acceptable S/N ratios measured at the receivers are 14 dB for an IEEE 802.3 Ethernet transceiver.

The most obvious method of reducing noise is to shield the wire in a metallic braid or sheathing. The shield is connected to a ground and protects cables from receiving and transmitting noise. Shielding increases cost and increases signal loss over distance at higher frequencies. This loss is a result of a capacitive effect between conductors and grounded shield.

Another solution to environmental noise is using balanced transmission lines—a requirement for successful transmission of 10 Mbps over unshielded twisted pair. A transmission line always requires two wires. In an unbalanced transmission, one wire contains the signal, the other a ground. Coaxial cable is unbalanced—a center wire carries the signal and a braided shield surrounding the center carries the ground. Normal voice transmissions and RS-232 signals are implemented as unbalanced transmissions over twisted pair and are susceptible to noise.

In a balanced transmission, both wires carry the signal, each with equal amplitude but at opposing phases. A balanced-to-unbalanced transformer (balun) recovers the signal at the receiving end by subtracting the signal on one wire from the signal on the other. Because external noise added to the line will be added to each wire of a pair in equal amounts, the noise is canceled out; this effect is called common-mode rejection.

Finally, the twisting of the wire itself reduces noise at low frequency levels. Noise spikes propagating along twisted pairs are attenuated when encountering twists.

The properties of twisted-pair wire that make it susceptible to noise also make it a noise generator. A run of twisted-pair wire behaves like an antenna, receiving and radiating electromagnetic signals. This can be a substantial problem, not generally at the primary signal components (5 and 10 Mbps) but rather with associated secondary harmonics. All high-speed twisted-pair transmission equipment should meet Federal Communications Commission (FCC) regulations for a Class-A (nonresidential) computing device to provide reasonable protection against interference in a commercial environment.

Second to noise, the most common element causing signal distortion in twisted-pair data transmission is *crosstalk*, which is unwanted leakage of signals from one wire pair to another. Crosstalk between wire circuits increases with length of circuit, wire proximity, signal strength, and signal

frequency. Bringing many wires together into one cable tends to increase crosstalk considerably; varying the length of the twists on nearby pairs tends to lessen it.

### IN WITH THE NEW

Anyone installing new cable for voice and data communications should consider the number of coaxial cables and twisted-pair wires needed and the merits of shielded versus unshielded cable. To avoid huge labor costs associated with recabling later, installers need to anticipate growth in data and voice applications. The AT&T Premises Distribution System (PDS) specifies two four-pair direct inside wire (DIW) cables to each station, and the IBM Cabling System using Type 2 wiring distributes two shielded and four unshielded pairs to each station.

A standard single-line telephone can operate on a single pair. The number of pairs required to operate telephones with special features depends on the type of telephone-switching equipment. Most PBX vendors can operate all phones on one, two, or three pairs of wire, although some may require up to four pairs. The old 1A2 key sets—once prevalent six-button telephones—can require up to 25 pairs to use all features, but cabling for 1A2 telephone systems today is rare because most are being replaced.

The number of pairs required for data depends on the application. Ethernet on twisted pair requires one or two pairs per workstation depending on the vendor. Token-Ring always uses two pairs, while coax devices attached



# VIRTUAL MACHINE TECHNOLOGY

#297 - 1155 West Georgia Street Vancouver, B.C., CANADA V6E 3H4 (604) 681-5684

Compatible, Reliable
Compact & Fast
Compact — a good description —

Dealer & Manufacturers Enquiries Welcome

# Standards Provide Flexibility

Our Netbios Standard Interfaces for Communication Devices are Compatible with the Major Network Operating Environments

- VMD\NET-ARC
  Netbios Interface for Arcnet
- VMD\NET-ETHER

  Netbios Interface for Ethernet
- VMD\NET-ASYNC
  Netbios Interface for Async



Looking at CASE tools? Ask these 10 tough questions before you buy.

# I Can we get all the tools we need?

Most CASE tools handle only isolated parts of the development process. KnowledgeWare's tool set covers the complete lifecycle – from planning to the generation of executable COBOL code.

# 2 Can we get just the tools we want?

With some CASE tools, you may be required to buy more capabilities than you need. KnowledgeWare's CASE solution is modular with separate tools for planning, analysis, design, and code generation that can work together...or alone.

# How well are the tools integrated?

Most CASE tool vendors offer tools that aren't well integrated with each other. KnowledgeWare's CASE solution is integrated to allow information to flow naturally from planning through detailed design and system construction. Each tool contributes to a growing body of knowledge stored in the Encyclopedia. As information is updated by one tool, the change and its effects are reflected in all other tools that use that information.

# How are diagrams stored in the tools?

The real value of diagrams in application development is the *meaning* behind those diagrams. KnowledgeWare tools use artificial intelligence technology to store the meaning of diagrams, not just the graphical representation. The Knowledge Coordinator™ translates your diagrams into Encyclopedia information that can drive the system's construction. And it automatically keeps the diagrams in sync with the Encyclopedia.

# Will the tools work with our current methodology?

Many CASE tool sets are tied to a specific methodology. KnowledgeWare's tools provide an environment where engineeringlike discipline is used to integrate existing approaches. So you can use any of today's popular methodologies, and capitalize on the experience you already have in your shop.

# Can we introduce the tools at any point in the development cycle?

Some CASE tools require you to follow a rigid development process step by step. Each of KnowledgeWare's CASE tools is tied to the others through a common Encyclopedia. You can start wherever you like and even work backward through much of the tool set.

# Can the tools help improve system quality?

Some of the tools available today are simply diagramming aids. KnowledgeWare's tools use artificial intelligence technology to provide *real-time* checking of consistency and correctness of diagrams as they are created. This catches errors early in the development process, where they are far less costly to fix.

# 8 How friendly is the user interface?

The CASE tools you select should communicate ideas as clearly as possible and make it *easy* for users to manipulate and modify these ideas. KnowledgeWare's CASE tools are mouse-driven with pull-down menus.

CIRCLE 132 ON READER SERVICE CARD

You can view many diagrams and definitions at the same time in multiple windows – and in different colors. You can zoom in and out, nest diagrams, mask out distracting elements, and highlight the path of information through a number of diagrams.

# Can we exchange data with other software we already have?

Most CASE tools only allow you to import and export information through specific interfaces to other products. But an interface to your particular software may not exist and may not be supported as either product evolves. KnowledgeWare products include a flexible import/export facility that ensures you can exchange information with your existing database management systems, fourth generation languages (4GLs), data dictionaries, etc.

# 10 Is there a plan for future advances?

KnowledgeWare has been following a master plan since its beginnings in 1979. We will continue to add even more capabilities to our current tool set. More powerful commands, more diagramming techniques, and more user-customizable features. Work is now under way to take full advantage of emerging technology such as IBM's SAA, OS/2, and Presentation Manager. This will lead to even more powerful tools in the future.

# A comprehensive CASE solution is as close as your phone.

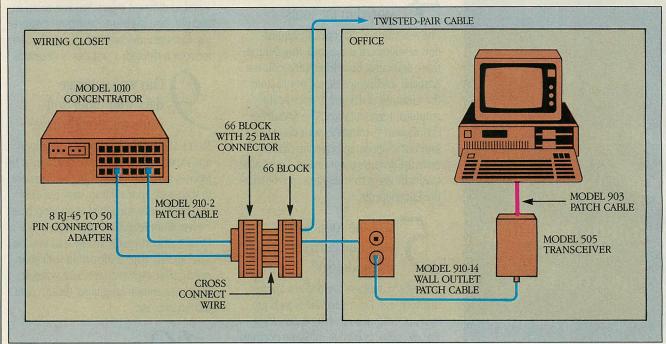
Naturally there's much more to learn about the extensive capabilities of KnowledgeWare's CASE tool set. For more detailed information, **call 1-800-338-4130 toll-free** (in Georgia, call 404/231-8575). And if you want to talk to one of our representatives, just ask when you call. KnowledgeWare, Inc. 3340 Peachtree Rd. N.E., Suite 1100, Atlanta, Georgia 30026.



# KnowledgeWare®

The World's Most Comprehensive CASE Tool Set™

# FIGURE 1: Simple LattisNet Configuration



The output from a standard Ethernet PC adapter card is converted by the transceiver for twisted-pair operation. Other vendors offer adapter cards with built-in transceivers. The distance from the transceiver to the concentrator can be 110 meters.

through baluns require a single pair. Some asynchronous connections, such as RS-232 printers and modems, may require three pairs or more. Although spare wire should be included for future expansion, it is possible to install too much wire; running 25-pair cable from each workstation to a wiring closet is unattractive because of the hodgepodge of wiring.

Shielded cables for data transmission have been standard for years to protect against noisy environments. Balanced transmission systems without shielding, however, can insulate well against noise without increased cable cost, size, and attenuation and can support speeds as fast as 10 Mbps.

### **NEW LIFE TO OLD WIRES**

The suitability of existing twisted-pair cable for high-speed data transmission depends on several factors, including distance from a wiring closet, the type and length of telephone cable in place, and available documentation. It also depends on sensitivity of the application to transient errors, strength of the noise-generating signal, and the network's tolerance to errors.

At high speeds, even moderate distances can cause severe signal distortion, but, fortunately, standard telephone wiring closets are close to the telephones they serve. An AT&T study showed that 97 percent of all phones

are within 55 meters of a wiring closet, 99 percent within 70 meters, and 99.9 percent within 100 meters.

Recent telephone installations, especially those with PBX systems, have been cabled with DIW, such as IBM Type 3 media. DIW is the highest performance twisted-pair wire in use—it is inexpensive and its attenuation and crosstalk properties at 10 Mbps are good. Another advantage is that it is easy to identify: it has a grey or beige vinyl jacket, and each pair has a characteristic color code: white/blue, white/orange, white/green, and white/brown.

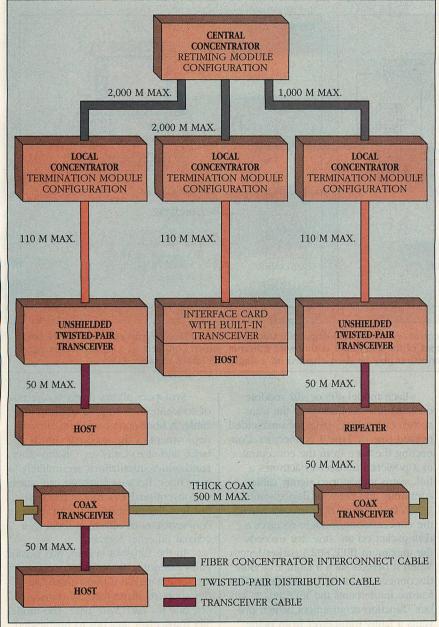
D-Station wire, also common in telephone installations, is constructed by twisting four conductors together in a single sheath (DIW contains up to four twisted pairs or eight conductors). D-Station wire is distinguished from DIW by solid-colored insulation on the conductors and is less suitable for high-speed transmission because of a high potential for crosstalk. A D-Station wire may be used if twisted pairs are chosen properly and not shared with other data applications. The wires furthest apart must be paired rather than the wires closest together.

Cable length is also important. If the cable-run length is outside the supported distance limits, then network transmission errors will be frequent. Even if distance limitations are met, testing is wise. The cable may not be a straight run from the closet to the workstation, or there may be bridge taps (for connecting many phones to a single line), wiring stubs, or filters for telephone circuit tuning. Any of these can make a wire pair unusable for data transmission. Older cables may have cracked insulation, extraordinarily long run paths, or may be in a high noise environment and thus unsuitable for Ethernet. Normally, the resistance of a cable indicates general suitability, especially if other factors, such as distance and wire characteristic impedances, are already known.

Existing cable is most likely sharing a cable bundle with other applications. The coexistence of Ethernet products and other balanced signals such as Token-Ring or 3270 balun converters usually is not a problem. Unbalanced signals, however, are a different story. RS-232 data is an unbalanced signal, as is a telephone ring generator. SynOptics claims its product can coexist in the same wire bundle as a 9.6-kilobit-per-second (Kbps) RS-232 signal, but testing specific applications is recommended if Ethernet is sharing a cable with higher speed RS-232 signals.

Possibly the worst source of unbalanced signals are those associated with analog telephone-ringing signals (digital ringing is seldom a problem). The AC ringing circuit used with inductive ringers can create large unbalanced voltage

# FIGURE 2: Large LattisNet Configuration



Twisted pair connects stations to a local concentrator, while fiber-optic cable connects local concentrators to a central concentrator. Existing coaxial-cable Ethernet can be connected into the system through a repeater and local concentrator.

spikes on the cable. With a short distance between the ring generator and the point on the punch-down block where the ring signal is combined with the data signals, spikes disturb transmissions in adjacent pairs. At longer distances, the cable's high-frequency attenuation of the unbalanced signal reduces the noise.

An often neglected consideration in reusing existing wire is the availability of original documentation. If each wire run has to be tested and labeled, labor costs may approach those of installing new wire.

Many older twisted-pair cable plants are not well documented. In this case, cable runs must be traced back to the wire closet from the work area with a tone generator or other test equipment. Assuming that existing wire meets general twisted-pair cable specifications, continuity testing is still recommended. A volt-ohm meter (VOM) can measure DC resistance at one end of a pair while the other end is shorted to obtain the *loop resistance*.

A time domain reflectometer (TDR) is used for in-depth cable measurements. It generates an ultra-fast (sub-nanosecond) voltage step waveform on the cable. When the pulse encounters a change in the cable's conducting characteristics (a fault or the end of the cable), part or all of the energy is reflected back to the TDR. Because the cable's propagation velocity is known, the time for the reflected signal to bounce back can be measured. The test pulse and any reflections are displayed on a screen or recorder, allowing precise measurements of cable distance, decibel loss, and characteristic impedance. An oscilloscope should be used in questionable situations to monitor the strength of induced line noise.

3Com has a product called the LanScanner that integrates some of the functions of a TDR, VOM, and oscilloscope for twisted-pair data-cable applications. The hand-held, battery-powered LanScanner measures cable distance, characteristic impedance and resistance, and detects low-frequency noise and voltage spikes.

### **CHOOSE YOUR VENDOR**

ment Ethernet on twisted-pair wire at 10 Mbps use a number of competing technologies, most notably single-direction signaling over two pairs of wire and bidirectional signaling using one pair of wire. SynOptics supports the former; 3Com supports the latter.

SynOptics. SynOptics' LattisNet system is the result of initial product development by Xerox at its Palo Alto Research Center (PARC) in California. The system's two basic components are a spe-

Products currently available to imple-

tem's two basic components are a special twisted-pair transceiver at each network device and a concentrator located in the wiring closet.

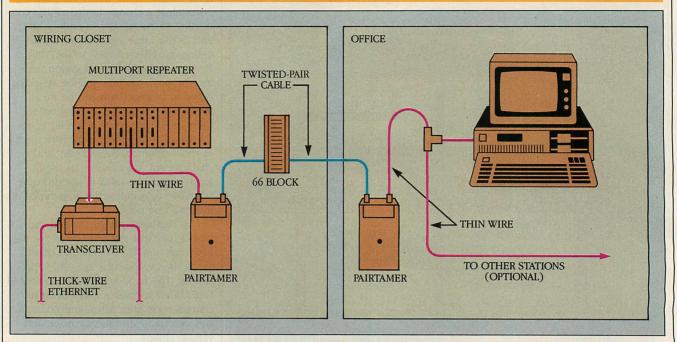
Each device needs a SynOptics' model 505 transceiver. Any suitable transceiver cable can connect a device

model 505 transceiver. Any suitable transceiver cable can connect a device to the transceiver. Each transceiver is connected to the twisted-pair wiring via a patch cord. The twisted-pair wire that is run from each station terminates in a wiring closet on a suitable punch-down block. Twisted-pair patch cords with RJ-45 ends connect the wiring block with the concentrator. This arrangement provides a fully contained Ethernet segment (see figure 1).

MICOM Systems Inc. has announced an Ethernet adapter with an integrated SynOptics transceiver on board, allowing a RJ-45 jack to be plugged directly into the PC card. Novell plans to offer a similar product. This integrated transceiver reduces the number of components needed at the workstation and simplifies connections there.

SEPTEMBER 1988 95

FIGURE 3: 3Com MultiConnect Configuration



3Com's MultiConnect repeater provides centralized wiring and diagnostic features. The PairTamer replaces a segment of coaxial cable with twisted-pair wiring. The output of the PairTamer is thin-wire Ethernet, which connects to a standard Ethernet adapter card on the PC. The thin-wire connection may be daisy-chained off a single PairTamer to other PCs.

Attachment to an existing Ethernet segment is possible at any available repeater attachment point. The output from a standard IEEE 802.3 repeater is fed into a model 505 transceiver terminated via twisted pair in a concentrator. Concentrators connecting existing segments must be within 1,000 meters of the central concentrator instead of the usual 2,000-meter limitation to remain within the IEEE 802.3 maximum network-delay specifications.

LattisNet concentrators are intelligent Ethernet controllers performing many of the functions regularly residing in the transceiver, such as collision detection, preamble, and heartbeat generation. Concentrators are configured by adding any combination of logic modules; a local concentrator can accommodate as many as 64 transceivers. SynOptics offers logic modules in different models to support fiber-optic connections, unshielded twisted pair, and shielded twisted pair.

Support for unshielded twisted pair is provided by the model 405 unshielded twisted-pair host module, an add-in concentrator logic module. Each model 405 module can support up to eight unshielded twisted-pair connections. The model 402 module supports shielded twisted pair with a 150-ohm characteristic impedance—for example, IBM Type 1 cable. A fiber-optic module is also available.

Each model 405 or 402 module contains line connectors to the transceiver, either RJ-45 jacks for unshielded twisted pair or Type 1 connectors. Connecting the wire from the concentrator to a powered transceiver activates a link status indicator to signify cable continuity and network device status.

A fault status LED turns on when the concentration module receives a data packet on any line that exceeds the maximum IEEE 802.3 packet length. When it detects such a fault, a module disconnects from the concentrator. This feature implements the IEEE 802.3 "jabber" function requirement, which prevents a faulty transceiver from being able to crash the network.

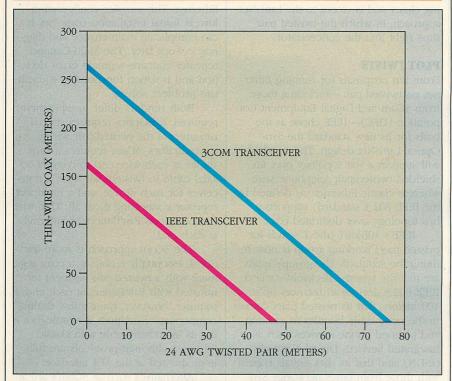
LattisNet networks are extended by adding up to two layers of concentrators. In figure 2, local concentrators are at the lowest level of the hierarchythey do not connect to any lower-level concentrators, only network devices. The central concentrator connects at least two local concentrators. A central concentrator contains one or more model 201 interface cards connecting local units through a fiber backbone. A central concentrator may optionally contain transceiver termination cards (such as those for models 402 and 405). Two or more central concentrators may be connected to a higher-level concentrator to provide a three-level hierarchical network.

SynOptics allows direct connection of concentrators only via fiber-optic cable. A fiber-optic backbone allows deployment of the maximal (in distance and size) LattisNet. On the other hand, older installations are unlikely to have fiber. Because LattisNet can attach to conventional Ethernet, a practical but less-elegant approach is to connect concentrators by attaching them to a coaxial Ethernet segment.

In the LattisNet system, two twisted pairs extending from the concentrator are terminated in a transceiver. Lattis-Net supports three types of transceivers, one for each wire type. The model 505 transceiver attaches to unshielded twisted pair, the model 502 to IBM Type 1 cable, and the 504 supports fiber-optic media. The transceiver provides an Ethernet-compatible interface between the LattisNet star cabling system and a network device using the IEEE 802.3 specifications for the AUI. Connection to the network device is via a standard 15-pin D-connector.

The maximum length of a twisted-pair station cable run in the LattisNet system is 110 meters. The transceiver cable connecting the network device with the transceiver can be up to 50 meters. Thus, the maximum device-to-concentrator distance is 160 meters. Flexible twisted-pair patch cables should not exceed 15 of the allowed 160 meters. Local concentrators sup-

# FIGURE 4: 3Com Hybrid Segment Distances



Twisted-pair and coaxial cable can be freely mixed in the 3Com implementation of Ethernet on twisted-pair cable. Extensive use of twisted-pair cable does, however, decrease the maximum allowable segment distances that can be used.

porting maximum length unshielded twisted pairs may be separated by as much as 4,000 meters in a two-level (central concentrator) network. **3Com Corporation.** With a large installed base of Ethernet products, 3Com follows a different direction. It adds support for twisted pair to existing Ethernet transceiver and repeater technology.

The 3Com approach shown in figure 3 replaces an Ethernet thin-wire coax segment with a length of twistedpair wire, each end of which is terminated by a PairTamer (a sophisticated balun and media filter). PairTamers require a single pair of wires, terminated in an RJ-45 jack as input. Output is through a standard thin-wire BNC coax connector. A set of PairTamers, one at each end of a twisted-pair segment, replaces an arbitrary Ethernet coax segment. This allows normal Ethernet thin-wire deployment, such as daisy-chaining, to be followed within certain distance limitations.

Configuration of an Ethernet workgroup can be accomplished in two ways. If a centralized wiring scheme is desired, each station requires two Pair-Tamers. One is wall mounted at the workstation, the second rack mounted in the wiring closet. A single pair of twisted-pair wire connects the Pair-Tamers. The output from the workstation PairTamer, thin-wire coax, is connected to the PC's transceiver. The coax output from the wiring closet's Pair-Tamer is connected to any standard multiport repeater. The alternative is to connect some stations by daisy-chaining, reducing initial wiring costs.

VEW TWIST FOR ELECRIST

3Com also has announced a new Ethernet component, the MultiConnect repeater, which is a modular multiport repeater normally residing in the wiring closet. The repeater can be configured with various module cards connecting to thick Ethernet or thin Ethernet segments. The base unit supports as many as 15 modules (each one connecting to a network segment) in any combination. Two expansion units, each supporting another 15 modules, can be added. A fully configured Multi-Connect can support 45 coax or twisted-pair Ethernet segments.

The MultiConnect provides a centralized management point from which network managers perform trouble-shooting and problem isolation. 3Com has included special partitioning features to the MultiConnect, allowing isolation of a faulty segment's module from the unit. For example, if a repeater module detects large numbers

of collisions, it automatically disconnects itself from the MultiConnect. When the problem stops, it automatically reconnects, leaving an LED indicator on the front of the repeater panel flashing. This way, network managers can monitor problem segments and manually disconnect each one.

The MultiConnect is not essential to the operation of Ethernet over twisted pair—any multiport repeater will suffice. The improved diagnostic capabilities it provides, however, are desirable in twisted-pair support. A uniform wiring system may be implemented by connecting each workstation to the MultiConnect with a set of Pair-Tamers. Alternatively, 25 stations/servers can be daisy-chained off of a single office-end PairTamer.

3Com's PairTamer wiring module allows IEEE 802.3 Ethernet to be installed over existing 22 to 26 AWG twisted-pair wire. It requires only one of the unused pairs in a typical wiring bundle; the Ethernet pair and the telephone pairs can share the bundle usually without interference. More than one pair in a multiple-pair bundle can be used for different network connections. It is compatible with most wiring schemes including AT&T's PDS and the IBM cabling system. Either unshielded or shielded twisted pair can be used.

The characteristic impedance of the twisted-pair wire must be set on the PairTamer at the time of installation. It comes preset to operate on wiring with a characteristic impedance of 100 ohms, but the network operator can change it, within a range of 70 to 150 ohms, using jumpers. 3Com's Lan-Scanner can determine the characteristic impedance and DC loop resistance. The maximum allowable DC loop resistance depends on the type of Ethernet transceiver the network segment uses. For 3Com transceivers, the maximum loop resistance is 13 ohms with PairTamers; for non-3Com transceivers, the maximum loop resistance is 8 ohms. If this value is exceeded, 3Com cannot guarantee network integrity.

Although 3Com supports both shielded and unshielded cable, allowable distances are slightly less with shielded cable due to capacitive attenuation. The allowable distances are a combination of the lengths of the twisted pair and coax (see figure 4).

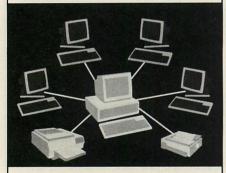
One welcome addition to the product line is a module specifically designed for twisted pair, containing the function of the PairTamer and repeater in one unit. 3Com has announced this product for availability in

# Discover The Multi-User Mini That's Hiding In Your 386 PC

Now you can have a complete DOSbased multi-user system with up to 11 people sharing a standard 386 PCwithout the cost and complexity of a LAN.

Using inexpensive terminals and the awesome power of the 80386 CPU, Music/386 lets each user on the system run any program and access any peripheral or data file, simply and inexpensively.

And best of all, Music/386 is fullycompatible with standard PC-DOS, so you can continue using all your favorite applications.



# Multi-User Computing Has Never Been This Easy... Or This Compatible

Only Music/386 gives your PC so much power at such low cost:

- Install and start multi-terminal computing in less than 8 minutes
- Maintain the highest compatibility with DOS, because you still have real PC-DOS
- Share databases, programs, printers and peripherals
- Perform multi-tasking (as many as 255 different sessions on the main console)

Call today to find out how easily and inexpensively you can move up to multi-user computing.

MUSIC/386
Multi-User System for Interactive Computing

BRISTOL INFORMATION SYSTEMS
84 North Main Street

Fall River, MA 02722-1031

(508) 679-1051

# A NEW TWIST FOR ETHERNET

September. This combination reduces the number of components in the wiring closet and is closer to the LattisNet approach, in which the twisted pair runs right into the concentrator.

### **PLOT TWISTS**

From ten proposals for running Ethernet on twisted pair—including those from 3Com and Digital Equipment Corporation (DEC)—IEEE chose as the basis for its new standard the Syn-Optics' LattisNet design. The standard will support a star topology over unshielded twisted-pair telephone wire, whereas classic Ethernet (as defined by the IEEE 802.3 standard) supports a bus topology over dedicated coax.

IEEE's 10BaseT (the T stands for twisted pair) working group is now refining the standard. The group's goals are that the system effectively connect IEEE 802.3 devices at distances up to 100 meters, that its twisted pairs coexist in the same cable bundles as existing and planned phone services such as Integrated Services Digital Networks (ISDN), and that its data signals coexist with those from other networks. Syn-Optics' current products may not conform to the final standard without modification.

The 3Com product does not conform to the draft 10BaseT standard, but is completely compatible with the existing 10Base2 (thin-wire) standard. Two PairTamers and a run of twisted-pair wire can be transparently interchanged with a thin-wire cable.

As vendors jockey for position around a new technology, incompatible products inevitably appear. Each product makes a trade-off between cost and performance that is acceptable for some applications, but inadequate for others. As the technology matures, concerns for interoperability and multiplevendor support drive the demand for standardization.

Synoptics' approach answers many of the current drawbacks of classic Ethernet. It enforces a centralized wiring plan, has integrated error diagnosis and detection, and runs on both shielded and unshielded twisted-pair wires. Devices can be 110 meters from the terminating concentrator.

The 3Com system is designed to support bidirectional signaling (transmit and receive) over a single twisted pair, instead of the two pairs required by SynOptics. Its distance limits (a maximum of 76 meters for 3Com transceivers, 47 meters for other brands) may be a problem, however, for some installations. It supports multiple de-

vices daisy-chained off a single Pair-Tamer through standard thin-wire Ethernet. This simpler configuration lowers initial installation costs, but it can complicate maintenance and diagnostic work later. The Multi-Connect repeater contains segment error detection and isolation functionality to facilitate problem solving.

Both vendors differ in equipment required. SynOptics requires special repeaters at the twisted-pair wiring concentrators. 3Com requires a Pair-Tamer at each wire end to convert co-axial cable to twisted-pair wire, a transceiver for each device, and a multiport repeater connecting them all. Thin-wire coax connects PairTamers to Ethernet at each end.

The 3Com approach is more traditional, essentially replacing a coax segment with a twisted-pair segment terminated with PairTamers at each end; it requires, however, quite a few distinct components. SynOptics is simple, but is not as interchangeable with classic Ethernet, although protocols are fully implemented at the AUI interface.

Alternatives such as 3Com's are attractive for sites with classic Ethernet that want to use twisted pair for new stations. The ability to use just one pair, rather than the two pairs required by SynOptics, may also be important for some sites. However, drawbacks include a greater parts count and the potential for configuration headaches if not used with a wiring-closet strategy.

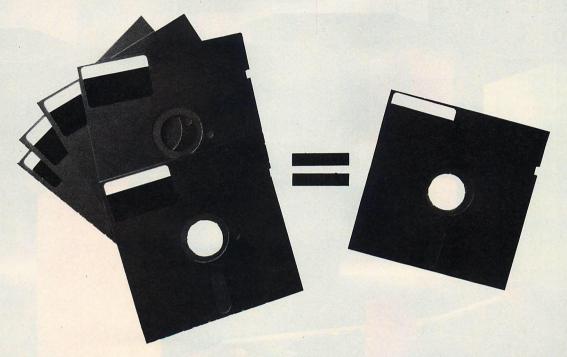
For most office installations, twisted-pair Ethernet can provide high-tech performance on low-tech wire. There is little reason to look elsewhere for wiring choices.

SynOptics Communications 329 North Bernardo Avenue Mountain View, CA 94043-5223 800/USA-8023 415/960-1100 LattisNet: \$350-\$500 per node CIRCLE 334 ON READER SERVICE CARD

3Com Corporation
3165 Kifer Road
Santa Clara, CA 95052-8145
800/NET-3COM
408/562-6400
MultiConnect: \$1,095
PairTamer: \$150
LanScanner: \$995
CIRCLE 335 ON READER SERVICE CARD

John Kolman is manager of systems engineering, Notis Systems Inc., in Evanston, Illinois. He has written for PC Tech Journal in the past on LANs and has installed Ethernet.

# RTLink PUTS MORE PROGRAM ON LESS DISKS!



# CLIPPER™AND QUICKSILVER™ USERS **OBTAIN UP TO 92% REDUCTION** IN .EXE SIZE ON DISK!

- No decrease in performance
- No reduction in available system memory
- No need to learn complex new input formats

.RTLink also works with Microsoft® C, MACRO Assembler and Borland International TURBO C®. — on any compiler or assembler which creates .OBJs in Intel® or Microsoft® standard formats.
.RTLink reduces the size of executable files

(.EXEs) on disk by eliminating redundancies in executable code among a group of executable files. .RTLink, in contrast to previous linkers, allows you to combine code which tends to be duplicated (library and user written) in many executable files into a single run-time library. This library resides in one place on the disk. It is combined with each executable at run time.

All Pocket Soft products are trademarks of Pocket Soft, Inc. Other brand and product names are trademarks or registered trademarks of their respective holders. ©1988 Pocket Soft, Inc.

CIRCLE NO. 194 ON READER SERVICE CARD

| YES! PLEASE SENDCOPY(S) OF .RTLink at \$495.00 per copy in Diskette Size:3½"5½" to: (Please complete or attach your business card).                            |
|--|
| Name   |
| Address  |
| Company — Phone —  |
| City State Zip   |
| Method of Payment: (Check One)   |
| □ *Check enclosed (U.S. Funds). Check should be made payable to POCKET SOFT, INC., and sent to POCKET SOFT, INC., P.O. Box 821049, Houston, Texas, 77282-9984. |
| Charge my Credit Card: ☐ MasterCard ☐ Visa   |
| Account No.:   |
| Exact Name on Card:  |
| Expiration Date:   |
| Signature:   |
| ☐ Send C.O.D.  |
|  |

To order by phone, or for additional information, call Bill Blake, (713) 460-5600.

\*Texas Residents please add 7% Sales Tax.



# OS/2's Dynamic Link

OS/2's powerful interface to applications, DLLs enhance and expand the operating system to an extent not possible under DOS.

MARY DEWOLF and TED MIRECKI

hether or not you've moved to OS/2—yet—there is no denying the many advantages it holds for developers. OS/2 is, at least to this point, an operating system geared toward developers rather than end users. But, in opening up so many opportunities for developers, end users ultimately benefit from better applications—and that's what they want anyway.

The modular, layered structure of OS/2 is one of its major strengths. Instead of a monolithic set of system-level programs (like its predecessor), OS/2 comprises three major layers: the kernel, the device drivers, and the dynamic link libraries (DLLs). As figure 1 shows, the DLL layer lies closest to the application level. It provides the application program interface (API) to the operating system; applications access all system-level functions through DLLs.

Because DLLs are distinct components not strictly bound to the kernel, developers can upgrade or extend API services without a major rewrite of the operating system—they merely replace

or add library files. Presentation Manager, the graphics interface of OS/2 1.1, is an enhancement that *replaces* the console I/O and other services of version 1.0. IBM's Extended Edition data management and communications facilities are services introduced by *adding* DLLs to the basic system.

Because of their position between applications and the kernel, DLLs can implement portions of applications as well as parts of the operating system. Instead of putting all the code of an application into executable (.EXE) files, a developer can put parts of it into a DLL. This offers two obvious advantages. First, if the application consists of several .EXE files, they can be smaller because common code resides in one DLL instead of being replicated in each .EXE file. More importantly, once a copy of a dynamically linked procedure is loaded into memory, it can be shared by several concurrent callers.

A dynamic link library, despite its name, is more like an .EXE file than a link-time library. It is compiled and linked like any other executable file. A linker definition (.DEF) file simply communicates to the linker that the output is in a .DLL file, not an .EXE. Although in principle a DLL can be written in any language, C and assembly language are the most convenient.

### THE TIME TO LINK

Dynamic linking takes place either at load time or runtime. The former is simpler because the operating system handles it entirely, making it transparent to the calling program; calls to dynamically linked routines are coded in the same way as calls to statically linked procedures (those incorporated into a program's .EXE file at link time).

The choice of static or dynamic linking is made at link time. If the same called procedures are available in both link libraries and DLLs, a program can be linked either statically or dynamically with no changes to the source code. The .DEF file simply informs the linker which called routines are dynamically linked. For these rou-

## OS/2'S DYNAMIC LINK

tines, instead of inserting the actual code from a link library into the .EXE file, the linker inserts *import records* that name the DLLs in which the code can be found at load time. When the program is loaded for execution, the loader processes the import records, locates the .DLL files, loads any not in memory, and inserts their addresses into the appropriate call instructions.

Load-time dynamic linking makes possible the call-based API protocol of OS/2. Without it, all routines invoked by call instructions are statically linked. For system-level services, this is impractical—the whole point of an operating system is to provide centralized services, to prevent every program from providing its own, perhaps incompatible, set of API functions.

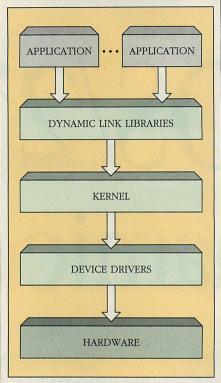
Although load-time dynamic linking provides simplicity (the operating system takes care of all details transparently), it does carry some trade-offs. Library names, for example, are hard-coded into the .EXE file and can be changed only by relinking the program. This requires access to the object code. In addition, libraries mentioned in the import records must be available at load time, even if all of them are not actually called. If a library is missing, OS/2 aborts the load process and issues message SYS1804, "The system cannot find the file XXXX."

An alternative method, *runtime dynamic linking*, defers the loading of libraries until requested by the calling program. A program must be written specifically to implement this method, using the following steps:

- Call DosLoadModule, passing it a string variable containing the name of the .DLL file to be loaded. If the function succeeds, OS/2 loads the library and returns a module handle.
- Call DosGetProcAddress, passing as arguments the module handle obtained in step 1 and the name of an entry point. If the call succeeds, OS/2 returns a far address to that entry point.
- Execute the dynamic link routine by means of an indirect call to the entry-point address.
- 4. When the DLL is no longer needed, the calling program releases it by calling DosFreeModule. All entrypoint addresses returned by previous calls to DosGetProcAddress become invalid, and calling any of the routines in that library requires going back to step 1.

Under runtime dynamic linking, the calling program performs more work and loses the capability to specify

# FIGURE 1: OS/2 Structure



DLLs are the highest level of OS/2, providing the interface to the application level. OS/2 can be enhanced without major rewriting of the kernel by replacing or adding DLLs.

dynamic or static linking at link time. In return, it gains more control over the linking process. The name of the library can be constructed dynamically on the basis of user input or a test of the hardware configuration. If a particular library is not available, the program can attempt some recovery, short of terminating, such as looking for an alternate library or reverting to a diminished mode of operation.

### **DYNAMIC DETAILS**

OS/2 performs the dynamic link in the same way for linking at both load time or runtime. First, the operating system determines if the required library is already loaded because of a previous invocation. If not, it locates and loads the library. OS/2 searches for .DLL files in the directories listed in the LIBPATH statement of CONFIG.SYS. If no LIBPATH is present, it confines the search to the root directory of the boot drive. Unlike PATH and DPATH, LIBPATH is not an environment variable. This ensures that the pointer to DLLs (some of which implement vital API services used by other portions of the operating system) cannot be changed without rebooting the system.

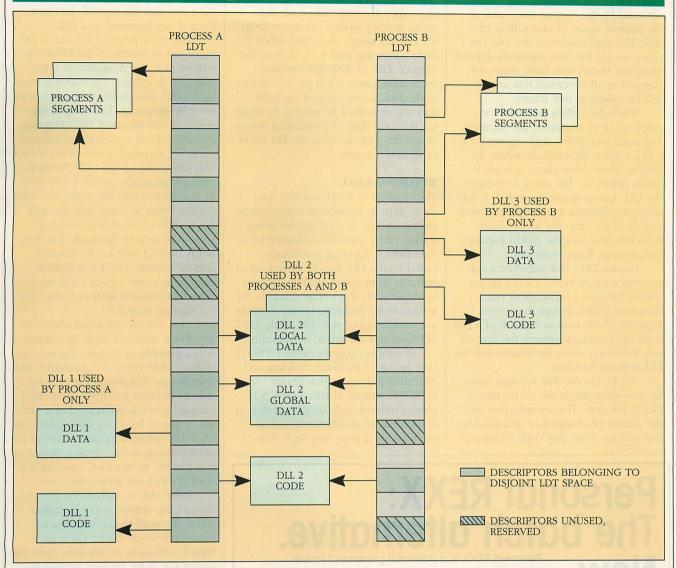
If the DLL is not already in memory, OS/2 loads it and maps it into the memory space of the calling process by entering the library segments into the descriptor tables of that process. Whereas static linking extracts individual routines from a link library, the dynamic link process loads the entire DLL, not just the routine being called. As with all executable files under OS/2, however, certain segments of it can be marked "load on demand" when the library is built. This defers loading those segments until they are needed.

In cases where the DLL is already loaded because it is being used by another process, it merely is mapped into the memory space of the new process. In the local descriptor tables (LDTs) of each process using the DLL, the entries defining the DLL's code and global data segments map the same physical locations in memory. However, the system creates and maps a new local data segment for each client process. For example, in a DLL that implements a video subsystem, the local data segments might contain the output of each process, while the global data segment could contain the semaphores that serialize access to the hardware.

When the system maps a DLL into an address space, it must perform a relocation process just as it does on an .EXE file. In protected mode, each reference to a segment address must be fixed up to reflect the actual location of that segment's descriptor in a descriptor table. This presents a problem if the DLL code is used by more than one process at a time, because then it must be mapped into more than one address space. Each mapping potentially requires a different relocation.

The design of an operating system can deal with this problem in several ways. One is to repeat the relocation process at each context switch, but this could extend switching time inordinately and degrade system performance unacceptably. Another method is to map DLLs into the global descriptor table (GDT) that is available to all processes. However, in OS/2, the GDT is reserved for system-wide, not processlevel, uses. In a third method, all references to DLL segments must be indirect, through addresses saved on the stack or other data segments local to each process. This method requires that dynamically linked routines be written differently than statically linked ones, making it difficult to write DLLs in compiled languages and losing the flexibility of choosing the linking method at link time.

# FIGURE 2: The Disjoint LDT Space



Part of every LDT is reserved for mapping shared memory objects. DLLs that are executed by more than one process are identically mapped into each client's LDT. This allows the DLL code to use one set of descriptors for all clients.

The method OS/2 actually implements is called disjoint LDT space. When creating a process, OS/2 assigns some of its LDT entries to the disjoint space for use by shared resources. When the system loads a DLL, it maps its segments into the disjoint entries, and reserves the entries in corresponding positions in the LDTs of all other processes. If the same DLL is subsequently mapped into the address space of another process, the descriptors in the same relative positions are used (see figure 2). As a result, the relocation performed on the initial load of the DLL is valid for all subsequent clients of the same DLL.

DLLs are not the sole users of the disjoint LDT space. All shared-memory objects, such as shared-memory segments, queues, and pipes, use it as

well. OS/2 1.0 allocates about one-half of each LDT to the disjoint space; version 1.1 allocates about two-thirds.

After mapping the DLL into the address space of a calling process and before entering the called routine, the system executes an initialization routine. When building the DLL, the programmer specifies whether initialization is global (performed only on the initial load) or per-instance (performed at every link to a new client process).

Once a DLL is loaded and initialized, the actual entry into the dynamically linked code is performed with a far call. Because by this point the DLL segments are mapped in the descriptor tables of the calling process, this call is just like any other: the target routine executes in the same address space and at the same privilege level as the call-

ing process. Therefore, no performance penalty is imposed for ring transitions through call gates (see the sidebar "How Protected Mode Protects" in "An Architecture for the Future," Martin Heller, November 1987, p. 66).

All routines in a DLL execute as part of the calling process. Even the global initialization routine runs as part of the process that issues the first reference to the DLL. In OS/2, only processes can own resources, so any resources obtained by a dynamically linked routine belong to the calling process and are not available from one execution to the next.

For example, a DLL initialization routine cannot open a file and save the file handle in a global data segment for use on subsequent calls. The next entry can be from a different process for

SEPTEMBER 1988 COA SERVANA DIGA SEAR AND A DIAMES TO SEPTEMBER 1988

## OS/2'S DYNAMIC LINK

which that handle is invalid or refers to some other file. Similarly, any memory obtained by the routine maps only in the address space of one calling process. The only resources the DLL can count on are the data segments defined when the library was built; these are mapped in all processes that are or will be linked to that library.

When the calling process terminates, all of its resources are released. The code and global data segments of a DLL remain allocated, however, as long as some other client process is active. When the last client terminates, the DLL segments are discarded. A subsequent reference to this DLL proceeds exactly as the first: the library loads from the disk, and the global initialization routine, if any, executes.

Certain DLLs that implement subsystems, such as video, cannot be unloaded because a subsequent reinitialization could disrupt the screen. Typically, these load as a result of a call from the operating system; the first client, therefore, never terminates and the DLL remains resident.

A .DLL file on disk remains open in deny-write mode the entire time a DLL is resident. This ensures that the file cannot be changed or deleted—for two reasons. First, any code segments

discarded in the course of virtual memory management can be reloaded. Because they are read-only, code segments are not written out to the swap file but are simply discarded; when restored, they are read back in from the original .DLL or .EXE file. Second, every time a new client process links to the DLL, a new copy of the local data segment must be read in to initialize the local data. The operating system closes the .DLL file once the last client process terminates.

### BUILDING A DLL

The creation of a DLL involves the same steps as creation of a stand-alone executable file. A programmer writes source code, compiles or assembles it, then links it. External procedures called by the DLL may be linked either statically from object module libraries or dynamically from other DLLs. As for a stand-alone program, library routines are usually linked statically, while OS/2 API functions are linked dynamically.

A sample program called DYNOTE (see listing 1) illustrates building and executing a dynamic link library. DYNOTE, written in Microsoft C 5.1, plays a musical scale on the speaker. It is useful as an audible indicator of multitasking activity (see Tech Note-

book, Ted Mirecki, January 1988, p. 165). The procedure that produces the tones and the intervals between them is implemented as a DLL.

The entry point of the DLL is the initialization routine. If the library is written in C, the programmer must take care to exclude the standard startup routine that contains the entry point for .EXE programs. The method suggested in the Microsoft OS/2 Programmer's Toolkit is to define the external symbol \_acrtused in one of the source files that make up the DLL. The compiler automatically inserts a reference to this symbol into the object file, forcing the linker to insert into the .EXE file the library module in which this symbol is defined. Normally, this symbol is defined only in the standard start-up routine, but if it is defined elsewhere in the source code, the reference is resolved without bringing in the start-up module.

This sounds like a reasonable theory, but it does not work. In practice, it is not possible to exclude the start-up routine when using the standard C runtime library. The routine is included anyway because it defines many other external symbols referenced in a variety of library functions. Fortunately, the OS/2 API functions provide many of the same services as the runtime library, so it is feasible to write a C program that does not call any library functions.

Even with no calls to the library, though, the definition of \_acrtused still is required to prevent an unresolved reference. Under OS/2, unresolved references at link time cause the output file to be marked nonexecutable. (Under DOS, a program with unresolved references runs as long as the instructions that made those references do not execute.)

The developer must write the DLL initialization routine to replace the start-up module in assembly language because it must inform the linker of the entry point, and compiled languages have no provision for doing so. As in the sample program (see listing 2, DLLENTRY.ASM), the initialization routine can be a simple skeleton that calls a procedure in another language to do the actual work (in this case, display a message).

The initialization routine is called from the operating system with a far call, so exit must be with a far return. Upon exit, the AX register must contain either value 1, for successful initialization, or 0, to indicate failure. In the case of failure, OS/2 aborts the program with no message and the DIL ini-

# Personal REXX: The batch alternative.

Now.

Personal REXX is a powerful general-purpose language bringing mainframe command and macro language capabilities to the PC.

Personal REXX offers you:

- A superset of IBM CMS REXX.
- The ability to develop powerful batch procedures.
- Compatibility with IBM SAA REXX command language.
- Windowing and menu support.
- Easy prototyping.
- The ability to interface with KEDIT text editor, and other applications.

Personal REXX runs on the IBM PC, AT, PS/2, and true compatibles using DOS 2.0-DOS 3.3. With Personal REXX, you can enjoy the many benefits of the macro language of the future. Today.



(203) 429-8402

Personal REXX Version 1.60 available at \$125 plus \$3 shipping. MC, VISA, American Express.

KEDIT is a trademark of the Mansfield Software Group, Inc.; IBM, IBM PC, AT, and PS/2 are trademarks of International Business Machines.



tialization routine must inform the user of the failure. The program that calls the DLL does not gain control before it terminates.

For DLLs that need no customized initialization processing, Microsoft C 5.1 offers an alternative that allows a DLL to access the C library yet avoid linking in inappropriate start-up code. The link library LLIBCDLLLIB supplied with the compiler is specifically designed for linking with DLLs. Along with all of the standard C runtime library functions, it provides an entry routine that is designed for initializing DLLs. A DLL can call C library functions as long as it is linked with this library instead of the default libraries used to create regular executable files.

LLIBCDLL.LIB is a static link library, so a DLL linked with it contains its own copies of all called library procedures. For example, if the DLL and the calling program both call printf, each executes a different copy of that function. This is exactly the same as two statically linked programs calling printf—each contains a distinct copy of that routine. But, just as several programs can share routines through dynamic linking, a program and a DLL can share the same code. The Microsoft C compiler provides the means for constructing a dynamically linked runtime library, thereby allowing multiple programs and DLLs to share the same library code.

Using Microsoft C, the developer can, in theory, write DLL routines to any memory model. Of course, the entry points must be declared far because they are in different segments than the calling program. Also, a model that allows multiple data segments is necessary if both global and local data segments are required. The major difference from a statically linked routine, however, is that during execution of a DLL routine, the DS and SS registers do not contain the same value.

In an .EXE file created by the Microsoft compilers, the default data segment and the stack segment both belong to DGROUP and are addressed from one base. In a DLL, however, the data segment is not part of the caller's DGROUP because the DLL is not linked with the caller.

As in any called routine, the DLL uses the caller's runtime stack. This places two requirements on the compiler used for writing DLLs. First, the code it generates must not make assumptions about the common base of data and stack segments. Second, at entry to a DLL routine, the DS register

(pointing to the caller's DGROUP) must be saved and loaded with the address of the DLL data segment. Microsoft C provides both capabilities with the /A compiler switches and the \_loadds key word in function prototypes.

Another problem related to the location of data and stack segments involves the process of testing for stack overflow on entry to a function. This process assumes that data and stack segments are in one group, with the stack at the high end of the group. Because the DLL's data and stack are in different segments, overflow testing does not work and must be disabled with the /Gs compiler switch.

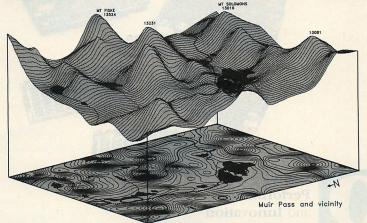
Listing 3 (MKDLL.CMD) is the batch file for building the sample DLL. When linking a DLL, the normal link libraries present for building an .EXE file cannot be deployed. To prevent their use, the /NODEFAULTLIBRARY linker switch disables default library processing. Two alternatives are available. The one exploited in the sample writes the DLL using only API functions and links with DOSCALLS.LIB. The second alternative is to link with LLIBCDLL.LIB, the special library for creating DLLs. Using this special library, the DLL code can include calls to C library functions.

The linker definition file is a new feature with no counterpart in DOS (although the linker used to build Windows applications also has this feature). This file determines if the executable file should be built as an .EXE or .DLL file. For the latter, it specifies the names of the dynamically linked routines, which data segments are local and global, and whether initialization is to be executed only at initial load or for every client. The definition file for the sample DLL is shown in listing 4 (DYNOTE.DEF). Because the .DEF includes no segment information, the DLL's data segment defaults to global.

When a .DEF file specifies that the output is to be a dynamic link library instead of a stand-alone executable, the linker automatically gives the output an extension of .DLL, unless the programmer specifies a different name as the second parameter. If the programmer does not specify a name, the linker issues a message indicating the actual output name.

DYNSCALE.C (listing 5), the driver program that calls DYNOTE.DLL, requires no special considerations to compile. At link time, the dynamically linked routines must be identified so that the linker does not attempt to load them from a link library. Two methods

# A NEW DIMENSION IN GRAPHICS



Plotworks revolutionizes its PLOT88 package to include three-dimensional contour maps at a fixed level. You can now project your two-dimensional contours into the third dimension for a unique visualization of your data.

PLOT88 is a library of more than 50 subroutines to construct grids, contour maps, and mesh drawings that outputs to printers, plotters and displays. A device-independent graphics package, it includes

PLOT, SYMBOL, AXIS and LINE—just to name a few.

Now your mainframe graphics programs can run on your personal computer at your convenience and at a fraction of the cost.

# PLOTWORKS, Inc.

Department J-7 16440 Eagles Crest Road Ramona, CA 92065 (619) 457-5090

"Toolmakers for the Information Age"

Australian distributor: EGS Graphics, P.O. Box 72, Kilkenny, S.A. 5009, (08) 46 9907

## OS/2'S DYNAMIC LINK

are available. The first is with import statements in a .DEF file (see listing 6, DYNSCALE.DEF). The other method creates an import library of all the routines in a DLL.

Whereas the .DEF file specifies the routines needed by the calling program, the import library specifies the routines available in a DLL. The developer may need to change the former list in the course of program development but must update the latter only if the DLL changes. An import library works at the link step just like a nor-

mal library of object modules. The linker searches it to resolve external names, inserting import records instead of the actual code into the .EXE file. DOSCALLS.LIB is an import library of all the API functions.

The developer creates an import library by processing a DLL with the IMPLIB utility. The same .DEF file used in the DLL's link step specifies the names of the routines for which import records are to be created.

To illustrate the difference between global and per-instance initializa-

Copyright 1988 Micronics Computers, Inc.

tion, start the DYNSCALE program in one session, then switch to another session and start it there also. Notice that only the first execution produces the message from the initialization routine. Now, change the first line of the .DEF file from INITGLOBAL to INITINSTANCE, run MKDLL.CMD, and copy DYNOTE.DLL to a directory that is mentioned in the LIBPATH statement. Start two concurrent copies of DYNSCALE; each one produces the initialization message.

The latest, protected-mode version of Microsoft CodeView (the one supplied with C 5.1 and MASM 5.1) is capable of debugging DLL routines. For best results, compile both the DLL and the calling program with the /Zi switch and link them with the /CODEVIEW option. To begin the debugging session with the sample .DLL, enter the following command:

### cvp /L dynote dynscale

The /L switch names the library file that will be dynamically linked to the program named in the second parameter. CodeView looks for the executable library file in the directories specified in the LIBPATH statement and for the source in the current directory.

In debugging an initialization routine, remember that with load-time linking, the routine runs before the start-up code of the calling program. In runtime linking, initialization takes place during the call to DosLoad-Module. Otherwise, tracing through a dynamically linked routine is no different than tracing through any other called module.

# POWERFUL FEATURE

Dynamic link libraries are a powerful feature of OS/2, giving this operating system a flexibility found in few others. Architecturally, OS/2 DLLs play a role similar to DOS terminate-and-stay-resident (TSR) utilities—both add capabilities that become an integral part of the operating system.

In their internal structure, however, DLLs are quite different from TSRs. In the DOS environment, developers needed proficiency in hooking interrupts and examining hot keys; in OS/2, a familiarity with building DLLs is key to taking full advantage of this robust environment.

Mary DeWolf is the owner of This is How, a consulting firm in Houston, Texas, that specializes in PC-host applications. Ted Mirecki is a technical editor for PC Tech Journal, specializing in operating environments and systems software.



CIRCLE NO. 112 ON READER SERVICE CARD

For a distributor near you, call

800 / 234-4386.

#### LISTING 1: DYNOTE.C /\* DynaNote: dynalinked function for playing a musical note. \* Copyright (c) Ziff Communications Co. and PC Tech Journal \* Written by Ted Mirecki #define INCL DOSPROCESS #define INCL SUB #include <os2.h> int \_acrtused = 0; /\* prevent link of C startup module \*/ void pascal far loadds DynaNote (int freq, /\* frequency of note \*/ long notetime, /\* duration of tone \*/ long resttime) /\* pause time \*/ DosBeep(freq, notetime); /\* Produce tone \*/ DosSleep(resttime): /\* Pause between notes \*/ /\* Initialization routine called by ASM entry routine \*/ int far \_loadds InitMsg() static char msg[]="DYNOTE.DLL has been loaded and initialized\r\n"; VioWrtTTv(msg. sizeof(msg), 0): return(1);

#### **LISTING 2:** DLLENTRY ASM

```
; DLL initialization module
```

; Copyright (c) Ziff Communications Co. and PC Tech Journal

: Written by Ted Mirecki

extrn \_InitMsg:far segment byte public 'CODE' text proc far dllentry call \_InitMsg ret

dllentry endp ends text

; The next statement is the whole point of this module: to specify a ; program entry point. This cannot be done in a compiled language.

dilentry

#### LISTING 3: MKDLL.CMD

OS/2 batch file to build DYNOTE.DLL.

masm dllentry /z /Zi;

if errorlevel 1 goto exit

CL -Asnu -G2 -Gs -Zi -c DYNOTE.C

if errorlevel 1 goto Exit

LINK dynote+dllentry/CO,,,DOSCALLS/NOD,DYNOTE.DEF

rem Destination path must be in LIBPATH in CONFIG.SYS copy DYNOTE.DLL c:\os2\dll\\*.\*

#### **LISTING 4:** DYNOTE.DEF

- ; DEF file for linking DYNOTE.DLL.
- ; The same file can be used by IMPLIB for building an
- : import library from DYNOTE.DLL.
- ; This line specifies creation of DLL, not EXE,
- ; and type of initialization, INITGLOBAL or INITINSTANCE
- LIBRARY DYNOTE INITGLOBAL
- ; This line names the entry points in the DLL EXPORTS DynaNote
- No segment attributes are specified.
- ; Data segments default to SHARED (i.e. global).

#### 9-Track Tape Drives: Yes! for IBM PC/XT/AT/386 and PS/2



Read or write 9-track tapes from mainframes and minis to your personal computer - including the PS/2 Micro Channel. Our TapeLinx 9-track tape subsystems offer these important features:

- 800, 1600, 3200, 6250 BPI
- IBM & ANSI labeled tapes
- Ouality customer service
- High speed controller
- Network backup
- EBCDIC/ASCII
- DOS, XENIX, Microport
- DOS device driver

For quick delivery we stock all major manufacturers' tape drives including Cipher, Kennedy, M4 Data, Qualstar. Prices start at \$3,795. Call Today!



#### Overland Data, Inc.

5620 Kearny Mesa Rd. • San Diego, CA 92111 Tel: (619) 571-5555 • FAX: (619) 571-0982

IBM PC, XT, AT, PS/2 (Personal System/2) and Micro Channel are registered trademarks of IBM Corp. XENIX and MS-DOS are registered trademarks of Microsoft Corp. CIRCLE NO. 185 ON READER SERVICE CARD

Get LANSbool™ for \$395 and Turn Any NetWare™ Workstation into a Print Server.

Lowest Memory Overhead • Dedicated/Background Mode Preserves NetWare Security • Works with NetWare Queues

Attaches Up to 7 printers • Familiar NetWare Menus



Order LANSpool now. Call (212) 431-8484

LAN Systems, Inc., 599 Broadway, New York, NY 10012

NetWare is a trademark of Novell Corporation. LANSpool is a trademark of LAN Systems, Inc

#### **VTEK™ 4.2**

### DEC® VT100/VT102/VT52 and Tektronix® 4010, 4014, & 4105 Terminal Emulator

#### Text Mode Features:

- 20 user-defined keys can delay, wait for a character, call other keys, and are encrypted.
- · large text scroll back buffer
- hardware or scrolling 132 column text mode
- Kermit and XMODEM error-free file transfers
- · "hot key" to DOS

#### New for VTEK 4.2:

- · 19,200 and 38,400 baud
- · PostScript® support
- · Switch among 4 printers

#### Graphics Features:

- Graphics are stored in 4096 X 4096 Tektronix 4105 format, and can be converted to .PIC, .GEM, or HPGL formats.
- scrolling VT100 window on the graphics screen
- · zoom, pan, and window plots
- up to 800x600 screen resolution on EGAs via hardware scrolling
- Most high-resolution graphics cards, printers, plotters and laser printers are supported
- · Replay plots on or off line
- Substitute PostScript<sup>®</sup> fonts for GrafText and change line widths

VTEK is designed by scientists to meet the needs of the scientific and engineering community for reliable and economical emulation.

Still \$150. Site and source code licenses are available

Scientific Endeavors Corporation

508 N. Kentucky St.; Kingston, TN 37763 (615) 376-4146

CIRCLE NO. 107 ON READER SERVICE CARD

### HIGH-SPEED — 16-BIT I/O AT → MAINFRAME



#### 9-TRACK TAPE

Catamount offers the Highest Performance 8-bit and 16-bit I/O 9-track tape subsystems for reading and writing Mainframe-compatible ½-inch magnetic tape on the IBM PC/XT/AT and compatibles such as the Compaq 386. Outstanding features include:

- 16-bit I/O, 128 KByte FIFO Buffered Interface for the AT and compatibles — No 8-bit bottleneck on the AT.
- Interface burst transfer rate capabilities greater than 1 megabyte/sec.
- Transfer data on either a DMA or Programmed I/O basis.
- Disk drive emulation software for direct tape data access with higher level languages and database management programs.
- D-type interface connector with shielded data cable for easy and reliable connection to the PC — No problem-prone Ribbon Cables.

Complete Tape Subsystems are available to handle 800, 1600, 3200, and 6250 bpi formats and are priced from \$3495. For more information, call today!



Phone: (805) 584-2233 FAX: (805) 584-0941

2243 Agate Court, Simi Valley, CA 93065-1898

#### OS/2'S DYNAMIC LINK

```
LISTING 5: DYNSCALE.C
  DYNSCALE.C - Program to produce do-re-mi scale on speaker
 * Demonstrates call to DLL function
 * by Ted Mirecki, PC Tech Journal
#include <math.h>
#define ONtime 100L
#define OFFtime 50L
#define NOTE DynaNote( (int)(freq+0.5), ONtime, OFFtime)
void pascal far _loadds DynaNote(int, long, long);
main()
           start = 100.0.
  double
            stop = 3200.0,
            freq,
            hstep.
            tonic:
   int n;
   printf("Audible Multitasking Indicator: MAJOR SCALE\n"):
   printf("Copyright (c) 1987, PC TECH JOURNAL ");
   printf("and Ziff Communications Co.\n");
   printf(" Written by Ted Mirecki\n\n");
            /* half-step frequency ratio = twelfth root of two) */
   hstep = pow(2.0, (double) (1.0/12.0));
   while (1)
                                       /* Begin infinite loop */
                                       /* Run up the keyboard */
      for (tonic=start; tonic<=stop; tonic*=2.0)
                                       /* Play ascending octave */
         frea = tonic:
         NOTE;
         freq *= hstep*hstep;
                                       /* full step */
         NOTE;
                                       /* re */
         freq *= hstep*hstep;
                                       /* full step */
         NOTE;
                                       /* mi */
         freq *= hstep;
                                       /* half step */
         NOTE;
                                       /* fa */
         for (n=1; n<4; n++)
                                       /* 3 more full steps */
            freq *= hstep*hstep;
                                       /* so, la, ti */
      for (; tonic>=start; tonic/=2.0) /* Run down the keyboard */
                                       /* Play descending octave */
         freq = tonic;
         NOTE:
                                    /* do */
         freq /= hstep;
                                    /* half step */
        NOTE;
                                    /* ti */
        for (n=1; n<4; n++)
                                   /* 3 full steps */
           freq /= hstep*hstep;
           NOTE;
                                   /* la, so, fa */
        freq /= hstep:
                                   /* half step */
        NOTE;
                                   /* mi */
        freq /= hstep*hstep;
                                   /* full step */
                                   /* end of while 1 */
                                   /* end of main() */
```

#### **LISTING 6:** DYNSCALE.DEF

; DEF file for linking DYNSCALE.EXE

- ; This line specifies creation of EXE file, not DLL.; It is optional, as EXE is produced by default.

  NAME dynscale
- ; Name procedures to be dynalinked, and from which DLLs. IMPORTS DYNOTE.DynaNote

Listings can be downloaded using PCTECHline, 301/740-8383. Parameters: 2400/1200/300 bps, no parity, 8 data bits, 1 stop bit.



# Which would you like to see first? The world's fastest dBASE compiler or the most powerful database development language?

Surprise. Now you get both in the same package.

New Clipper™ from Nantucket.®

Our latest version - Summer '87 - is still the bestperforming compiler ever. It lets users run dBASE® applications up to 20 times faster. But there's a lot

more to it than raw speed.

Because new Clipper is one of the most powerful, full-featured development languages ever. And gives you more control over your applications than any release of dBASE ever will. Now or in the future.

Instead of designing Clipper as an add-on, we've structured it as an extended database language that uses dBASE as a subset. In addition to emulating the dBASE language, we've added commands for menus, screens, windows and extended functions. As a result, you get dBASE compatibility and an entirely new level of power and versatility.

And with Clipper's open architecture, you can write functions in Clipper, C, Assembler or other languages, and integrate them into one seamless

application. Which helps you create more sophisti-

cated applications in less time. And by using our full-featured debugger, you'll be done even faster.

We also give you source code security that keeps users from damaging your application. And sophisticated record and file locking capabilities that make networking applications easier to create. But no matter what you create, you don't have to buy runtime modules or additional software. You don't

even have to pay licensing fees.
If you haven't tried Clipper yet, just call (213) 390-7923 today. We'll send you full information and a free demo diskette. Or the complete program,

if you'd rather.

But call today. And see how easy it is to find the best dBASE development

language. Just get the fastest compiler. And open the box.



Nantucket, 12555 W. Jefferson Boulevard Los Angeles, CA 90066 Telex: 650-2574125



© Nantucket Corporation, 1988. Nantucket is a registered trademark and Clipper is a trademark of Nantucket Corporation. dBASE is a registered trademark of Ashton-Tate.

# Building up to IEW/WS

ANDREW TOPPER

If KnowledgeWare Inc. were to place a classified ad seeking users for its computer-aided systems engineering (CASE) tool called Information Engineering Workbench and Associated Workstations (IEW/WS) 4.0, it would probably read: "Wanted: Systems integrators and developers working for sizable corporate customers. Must be well-versed in software development structured methodologies and looking for a flexible, powerful CASE tool to automate and integrate the planning, design, and analysis phases of software development."

KnowledgeWare makes no claims of teaching developers how to do systems planning, analysis, or design, and its approach definitely is not geared toward the freshman CASE developer. The package as shipped has no on-line tutorial and no sample system, so the developer must already know structured methodology principles (see "The CASE for Structured Development," Carma McClure, August 1988, p. 50) or plan to pay for additional training. IEW/ws's target audience is the developer working on a corporate-wide design. The product's portability between the mainframe and the PC is rate software developers.

IEW/WS differs from most CASE products for the PC in its integrated approach to systems development.

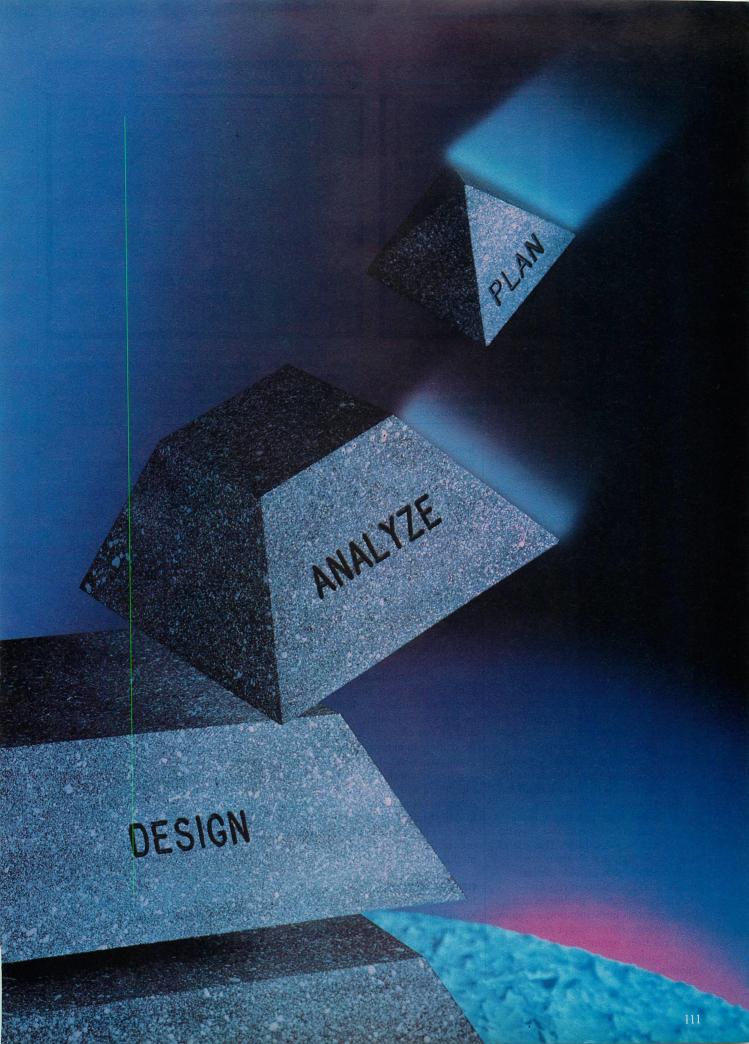
Whereas other CASE tools concentrate on the analysis or design phases, IEW/WS includes not only those phases, but also planning. KnowledgeWare is also one of the first companies to bring the *information*-engineering approach to CASE on the PC. Other CASE tools, such as Index Technology's Excelerator reviewed last month ("Excelling with CASE," Andrew Topper, August 1988, p. 70), take the *software*-engineering approach. IEW/WS also is among the first CASE tools to use a windows interface.

The product consists of three integrated but separate modules, termed *workstations*. Each workstation sells for \$8,600 (with volume discounts for two or more). An introductory package with all three workstations is \$10,000.

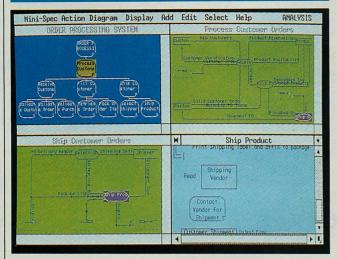
The planning workstation has tools to manage business goals and organize the factors that will lead to success of the system. The analysis workstation models data and processes required for a specific business function. The design workstation describes how data and processes will be implemented at a physical level. A fourth major component in systems development—construction of a system, including generation of executable code, testing, and implementation—is not addressed by iewws.

KnowledgeWare's workstations operate under GEM, a graphics user KnowledgeWare's IEW/WS stacks three integrated workstations—planning, analysis, and design—into one package to help build monumental systems.



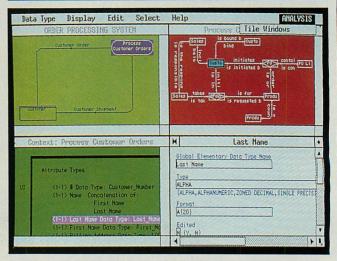


#### PHOTO 1: Process Modeling



A decomposition diagram shows a system as a hierarchy of processes (upper left). Process Customer Orders is detailed in a data-flow diagram, and the Ship Customer Orders process is broken down into lower-level processes (lower left). Ship Product, which is a sequential process, can be expressed in program-level steps using an action diagram.

#### PHOTO 2: Data Modeling



A high-level data-flow diagram (upper left) shows input and output for Process Customer Orders. An entity-relationship diagram details the components of the process, and entity-type descriptions (lower left) detail attributes of each entity. A data-type window shows legal COBOL data types for each attribute. The GEM interface allows tiling of windows.

interface from Digital Research Inc. Like Microsoft's Windows, GEM provides menu bars, pull-down menus, and windows that can be sized, moved, overlapped, and tiled.

One of IEW/WS's important facilities is the Encyclopedia option. Once created, an IEW/WS encyclopedia is a superb rendering of the traditional CASE central repository for storing and accessing complete information. Using this option, the developer can create encyclopedias for any project or part of a project. An encyclopedia stores all elements, diagrams, and reports entered and provides detailed documentation on each entity in every diagram. Once an item is defined, it may be used in any workstation, diagram, or report via the Encyclopedia option.

Another powerful feature shared by the workstations is the encyclopedia's "intelligent" Knowledge Coordinator. Using more than 1,000 rules of diagramming entered by KnowledgeWare, the Knowledge Coordinator restricts the developer from entering information into the encyclopedia that may be inconsistent or incomplete. This use of rules differs significantly from other CASE products that provide syntaxchecking and verification reportswhile reports identify problems in a design prior to implementing a system, the Knowledge Coordinator prevents problems from getting into the system.

The information-engineering methodology pioneered by James Martin is the basis for IEW/WS. It decomposes a

logical data model representing information usage across an organization into smaller and smaller units until program modules can be expressed in pseudocode. The modules can serve as the basis for generating executable program code. KnowledgeWare links the workstations to code generators (such as its own GAMMA and Pansophic's Telon PC) on IBM mainframe computers.

Several features contribute to IEW/WS's flexibility. Developers can choose icons (see figure 1) for diagramming and can choose diagrams used in the information-engineering and Yourdon structured methodologies.

In addition, the windowing capability permits more than one diagramming tool within a workstation to be on screen at one time (see photos 1 and 2). For example, a developer can be editing an entity-relationship diagram and quickly bring up a data-flow diagram to check attributes or object placement without losing the original diagram. Changes made to an element in one diagram are made in encyclopedias and in all other diagrams that reference that item; all windows are immediately updated.

#### ON YOUR MARK

Installing IEW/WS requires running a KnowledgeWare Install utility that verifies that the computer equipment has the resources needed to run the product. The program displays a warning message for each parameter that tests negative. Some problems (such as a

processor that is not supported) prevent the product from being installed, while others (such as insufficient expanded memory) allow installation but inform the user of discrepancies in the system. The IEW/WS cannot be used with terminate-and-stay-resident (TSR) programs such as Borland's SideKick or SuperKey, or the DOS PRINT command.

IEW/ws requires an IBM PC/AT, PS/2 Model 50 or 60, or 80386-based computer with a minimum of 640KB RAM and 20MB of hard-disk space, an EGA or higher-resolution display, and a mouse. KnowledgeWare recommends 3.5MB of extended or expanded memory, 1.5MB of it designated as a virtual disk. Disk requirements for the three workstations combined can be expensive. The empty encyclopedia alone uses more than 11MB of disk space.

For systems to be implemented on IBM mainframe computers or compatibles, the design workstation supports Customer Information Control System (CICS) screens and Information Management Systems (IMS) databases. CICS is probably the most popular terminal control software package for large IBM mainframes, and IMS is a popular hierarchical database management system for these machines. CICS and IMS screen support gives large MIS shops and consultants a platform for development not found in other PC-based CASE toolkits. The diagramming tools that help design IMS databases augment physical design of a software product when IMS is used.

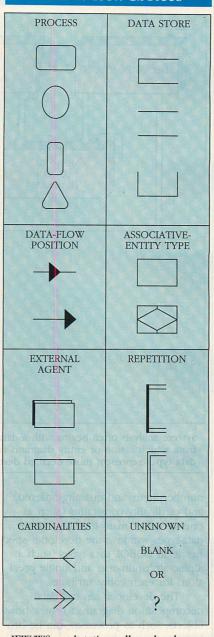
Accessing and switching between workstations is simple and direct from a workstation-selection menu using the keyboard or directly from DOS. The system allows access to each workstation only after users give IDs and passwords. No mechanism exists for accessing more than one workstation at a time. However, developers can see a list of entities entered from other workstations, using the Details option via the Object List function. Once in a workstation, the GEM interface with mouse and keyboard input is intuitive. It makes the IEW/WS easy to use by providing a consistent user interface across the product line and allowing multiple diagrams and reports to be viewed simultaneously.

In each workstation, the main menu bar has selections for Workbench (to access DOS, load data, copy encyclopedias, and exit the system), Display (to select diagram and report capabilities), Profile (to customize system options, such as colors, icon appearance and size, and passwords), and Help (for on-line assistance in using the current feature). Moving the arrow with the mouse onto a menu option provides a pull-down menu from which further selections can be made. Diagrams and reports available from the Display pull-down menu differ depending on which workstation is active.

The developer tailors the environment of each IEW/WS workstation with the Profile option. In addition to window color, scale of diagram icons, window conventions, form of printed reports, and destination of reports, the developer can specify symbols and conventions to use when diagramming (see figure 1). Once symbol types are changed, all diagrams in all encyclopedias use the new symbols. The project leader or manager can limit which users are allowed to modify diagramming symbols within the system via the User List option on the Profile menu.

Each workstation comes with a single, three-ring binder consisting of an Installation Guide, a Basics Book, a User Guide, and an Export/Import Guide. Only the User Guide differs among the three workstations. Documentation is concise and complete, and on-line help is available within each window and for each prompt within the system. KnowledgeWare offers a training session for \$2,250 that uses excellent tutorials and sample encyclopedias. The company should consider making these materials part of the standard package to assist novice users. Additional customer support consists of

#### FIGURE 1: Icon Choices



IEW/WS workstations allow developers to select icons from a menu available via the Profile option on the main menu. All similar objects in encyclopedias are depicted by that icon.

a 90-day diskette warranty, a 90-day software and documentation update, and free hot-line support.

#### EXHAUSTIVE ENCYCLOPEDIA

The encyclopedia is the web that ties together all entities in the system—it stores objects (processes or entities), properties (definitions), and associations (relationships) among objects. As a central repository, it greatly reduces redundancies in the system and helps eliminate inconsistencies among objects shared by different phases of the soft-

ware-development life cycle. Through the encyclopedias, reports can be printed, diagrams generated, and objects maintained throughout the life of the system. Each object in an encyclopedia has its own detail screen to describe it.

Developers can create encyclopedias that can be project- or groupspecific and can be shared among the IEW/WS workstations. Developers can combine objects from multiple encyclopedias into a master encyclopedia. Encyclopedias can be copied, renamed, deleted, backed up, or restored via the Encyclopedia List window available from the Display pull-down menu.

Currently, an encyclopedia can be backed up only if it is not open, and must be backed up to diskettes. If an encyclopedia grows large, this might be cumbersome. A better option would be to back up an encyclopedia to another hard disk or to tape. Once backed up, an encyclopedia can be restored using the Restore option.

An encyclopedia Repair utility available from the workstation-selection menu repairs damaged encyclopedias. An Object List function specifies objects (such as diagrams, records, and modules) entered into an encyclopedia using any of the IEW/ws workstations. The developer can display information about objects selected or report on any objects in the list. Object-list entities are selected via search criteria, including type of object, its name, its project or group, the date and/or time the object was last updated, or the user that created it. Object lists can display the details of objects entered from other workstations.

The Consolidation option from the Workbench menu copies data in an encyclopedia to a DOS file or merges data in different encyclopedias into one encyclopedia. Developers can consolidate selected objects in an encyclopedia, specific types of objects, or an entire encyclopedia.

Because no single CASE toolkit provides all tools required to support all phases of software development, it is necessary to migrate data collected or generated from one phase to another. Each IEW/WS workstation has import and export options available from separate utility programs. Unfortunately, both programs use an intermediary file that requires data to be in four different ASCII files specific to IEW/WS. Encyclopedias are imported by creating four import data files, running the Import utility, and consolidating the resulting output file with the encyclopedia.

SEPTEMBER 1988

One capability missing from IEW/WS is the ability to limit access of specific encyclopedias and objects to individual project team members. This could prevent unauthorized persons from modifying or deleting entities. Also missing is an explicit statement in the documentation of system limits, such as number of objects and levels allowed in an encyclopedia.

#### **BEGIN WITH A PLAN**

Planning involves identifying business goals and factors critical to the success of a system or software product and creating an enterprise model (which shows a company's goals, functions, and factors that users determine are critical).

IEW/ws's planning workstation has tools to help developers create an enterprise model, establish a basis for software development that supports the model, and manage development efforts. Diagramming tools for planning include decomposition diagrams (to describe the components of a system hierarchically from a general view through a detailed view) entity-relationship diagrams (to depict objects for which data are collected in the system and relationships among them), and matrix diagrams (to describe associations between objects in a system and common properties among objects).

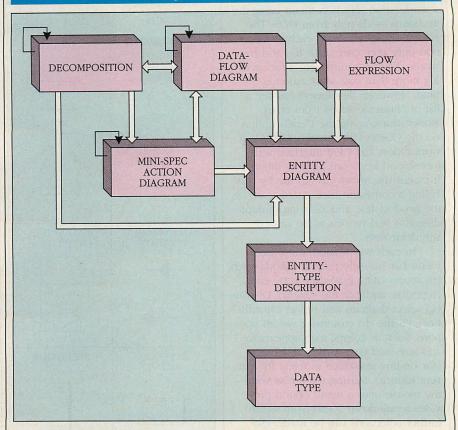
Corporations that can benefit from this product are those using the information-engineering methodology and those seeking to integrate business planning with strategies for analysis and design. Developers for smaller organizations likely will find it a luxury rather than a necessity and may find the two other workstations more in line with their development needs.

#### **ANALYZING THE OPTIONS**

The analysis workstation includes tools for modeling the data and processes that make up a system or software product. Figure 2 shows how these tools interact. Structured analysis usually begins with a data-flow diagram to show overall flow of data and resulting transactions in a system. The diagram shows objects that compose the system, such as processes, data stores, external agents, and data flows; it can be broken apart to show component processes. Data-flow diagrams can be created for each lower-level process.

For each object in a data-flow diagram, an entity diagram shows entity types and relationships. An entity-type description specifies details such as entity name, attributes (such as order

FIGURE 2: Overview of the Analysis Workstation



System analysis often begins with a data-flow diagram or a decomposition diagram from which action or entity diagrams can be defined. Entity-type descriptions and data types represent more detailed descriptions of the system's modules.

number, item, and quantity ordered), and cardinality constraints (such as one-to-one or many-to-many). In the data-types window, the developer specifies legal COBOL data types (such as alpha, alphanumeric, and single precision) for each entity attribute.

The developer can use datadecomposition diagrams to show how objects, such as processes, can be broken down into objects. Action diagrams detail the steps within a process. Data-flow diagrams. Data-flow diagrams generally depict detailed activities or functions and data passed among them. They are usually created from functions described in a high-level (general) decomposition diagram. IEW/WS supports the Yourdon-Constantine data-flow diagram. In a data-flow diagram, data that flow into a process must be transformed and passed on to some other process or to a data store. This is called the law of data conservation.

The analysis workstation supports standard data-flow diagram components, including data stores, processes, external agents, data flows, and junctions to other diagrams (see photo 1). It does not support Gane and Sarson

symbols for data stores and external agents. A data store is a place where data are held available for other processes, such as a customer file. External agents are objects that act on data from outside the system, such as the Accounting Department. Junctions split data into one or more outputs or combine inputs into one or more flows. Reports check data-flow diagrams for accuracy and completeness.

iew/ws allows definition of flow expressions that describe the components making up a specific flow of data in a data-flow diagram. Valid components of a flow expression are data flows, entity types, attribute types, and relationship types. Flow expressions can include valid entity names or wild-card expressions such as \*. Attributes in a flow expression can be grouped within parentheses and have operators such as And and Exclusive Or.

Entity and data types. To identify information required to create data structures and files (model the flow of information in the system), the analysis workstation supports five types of entity-relationship diagrams: subject area, process, data store, data flow, and ex-

ternal agent. The subject-area diagram combines all other entity-relationship diagrams in the encyclopedia showing relationships between two entity types. Process, data-store, data-flow, and external-agent diagrams describe entities and relationships within a data-flow diagram. Entity descriptions and relationships can be shared among different parts of the total system.

Entity-relationship diagrams use boxes to represent entities or logical records, and lines connecting them to show relationships (see photo 2). Encyclopedias store detailed descriptions of entities and relationships by way of a Detail window.

Entity-type descriptions define attributes (characteristics or values of an entity) and cardinality constraints for an entity and its relationships (see figure 3). An attribute of a customer entity might be customer number, name, or billing address. Attributes can occur once or many times within the entity; cardinalities and relationships (such as belongs-to-sales-region) are described via the entity-type description screen.

Legal COBOL data types can be established for attributes, which can be combined into groups. For example, "Last name" can be specified as data type *alpha*, format A(20). Entity types are related to entities they describe in the specified entity-relationship diagram and are therefore applicable only in that context. Data elements can be used several times within an encyclopedia on different entity-relationship diagrams with separate entity-type descriptions used in each.

**Decomposition.** To specify the flow of activities in the final system and subdivide a complex system into its subcomponents—a process called functional decomposition—the analysis workstation delivers decomposition diagramming tools. With them, the developer can break down high-level objects into low-level (more detailed) objects to identify all system functions. IEW/WS supports process-decomposition diagrams, data-decomposition diagrams, and organizational charts. In processand data-decomposition diagrams, rounded rectangles or circles depict the process or data, and lines show hierarchical relationships.

Decomposition diagrams are generally used for process modeling. Within a process-decomposition diagram, processes that can be decomposed further are designated with the letter P in the lower-right corner of the box. When processes have action diagrams defined for them, the letter S

appears in the lower-right corner of the box. For example, the process Ship Customer Orders can be broken down into two smaller processes, Select Shipper and Ship Product.

The developer can limit the number of levels of a decomposition diagram to avoid cluttering a high-level decomposition diagram. Objects in a decomposition diagram relate to other entities in an encyclopedia. Processes can relate to a data-flow diagram, an entity-relationship diagram or an action diagram. Organizational charts do not

relate to any other entity in an encyclopedia but help describe staff responsibilities within an organization.

Action diagrams. Action diagrams use standard programming constructs, such as block structures, conditional statements, and data-access statements, that could completely define a functional component and textual description (see figure 4). Action diagrams assist developers in building applications with fourth-generation languages (4GL) because the content of the action diagram can map to 4GL commands.

#### 386 HummingBoard

# TWO PROCESSORS ARE BETTER THAN

ONE

When it comes to 386 add-in boards, the HummingBoard is in a class by itself. It is a true coprocessor that makes productive use of the base system's original 8086, 286 or 386, running it in *parallel* with the HummingBoard's 386.

#### You can adopt a whole new PC strategy.

Put your demanding applications that need more speed or memory, like 123, dBase, Auto-Cad, compilers, etc., on the HummingBoard while your network, Desquiew, disk cache, TSR's and other applications run concurrently in the *other* 640k on the "base" system.

Our new Second Shift™software permits running a time consuming compile, report or other program totally in the background on the Hummingboard



while you continue to use your base system for other tasks.

#### Turn 640k into 900k

Another HummingBoard benefit is more memory for DOS programs, without changing your software. On the HummingBoard, many DOS applications can address from 700k up to 900k directly, without EMS. EMS 4.0 is supported as well.

#### **Blazing performance**

With 16, 20 and soon 25Mhz versions, plus 32-bit cached memory for no-wait-state performance, the HummingBoard is at the top of the class for fast 386 systems.



#### A.I. Architects

One Kendall Square, Cambridge, MA 02139 (617) 577-8052 FAX (617) 577-9774

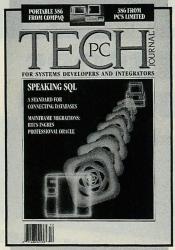
CIRCLE NO. 253 ON READER SERVICE CARD

SEPTEMBER 1988

#### IEW/WS

# ATTENTION RETAILERS..

YOU SHOULD CARRY PC TECH JOURNAL, THE MAGAZINE FOR IBM PC SYSTEMS PROFESSIONALS.

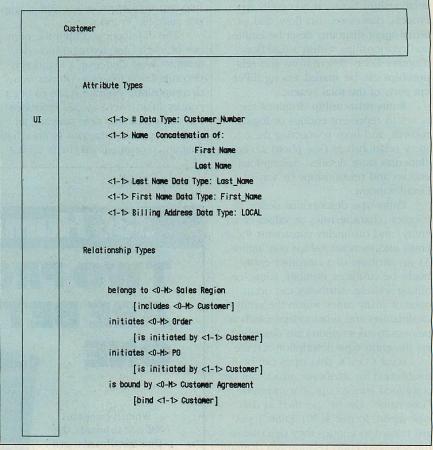


very issue of PC TECH JOURNAL speaks to your advanced customers who are systems designers, developers, integrators and DP/MIS professionals. Increase the sale of the applications software, languages, operating systems and hardware you carry with the most respected magazine written for sophisticated IBM PC professionals—PC TECH JOURNAL.

For more information on how you can carry this "silent salesman" for greater profits, call (212) 503-5331 or write:

Chris Cherry—
Retail Sales
Representative
Ziff-Davis Publishing
Company
One Park Avenue—
New York, NY 10016

#### FIGURE 3: Entity-type Description



Attribute and relationship types for all entities in a system are detailed in an entity-type description. The Customer entity is described by number, name, and billing address and is involved in the four relationships indicated in the description.

Action diagrams offer several advantages over traditional flow charting and pseudocode, including linkages to a data model. They can be printed on normal-width paper and can be automatically cross-checked. Their use of established programming concepts and structures, such as If . . . Then and Else . . . While loops, makes them easy to teach to programmers and analysts and easy to convert to a specific programming language.

IEW/WS supports the standard action-diagram components and also provides a powerful text-editing environment for creating and maintaining them. Capabilities such as Search, Replace, Cut, Copy, and Paste make it easy to modify action diagrams. These diagrams share information with dataflow diagrams, decomposition diagrams, entity-relationship diagrams, and other action diagrams. Perhaps the best potential benefit of action diagrams is their ability to map almost directly to higher-level languages, which can lead to code generation.

**Reports.** A Reports option in the analysis workstation allows the developer to diagnose potential problems not caught by the Knowledge Coordinator. It prints information based on the contents of an encyclopedia. This two-tier verification system means developers can be extremely confident of a specification's correctness. Reports, including connectivity analysis, data conversion, data-flow course analysis, and flow expression, can be initiated from either the diagramming component they report on or from the object list.

The connectivity-analysis report lists all invalid data flows in data-flow diagrams. The data-conversion report identifies data-flow diagrams containing objects and flows that do not follow the law of data conservation.

The data-flow-course-analysis report describes data flow through all data-flow diagrams in the system. It can be requested for all levels or until a data-flow name changes and can list all components or only the ultimate sources and destinations for the data.

# MICS AWA: Small Language Mich Big Power. Small Language A terse, casy to-learn with Big Power. It for your FC, Mics Awk It for your FC, Mics Awk It for movice to expert. It for movice to expert. It pattern rationing and diagnostic for the serious and statistic for the serious of t

If you're not satisfied with the capabilities of IBM's 3270 micro-mainframe software, we'll buy it from you.

Attachmate's 3270 software for the PC and PS/2<sup>™</sup> overcomes IBM's limitations. It takes less memory, and includes features that IBM either sells separately, or doesn't offer at all.

Plus, it's the industry's only fully IBM-compatible 3270 software alternative. You see, we also buy into IBM's connectivity standards, and we have no intention of making up our own. So we can all worry less about what IBM might do next year.

Our offer is simple: Each 3270 emulation software product you trade in is worth \$200 against a copy of Attachmate's EXTRA! Connectivity Software. Your 3270 coax adapter is also worth \$200 against Attachmate's IBM-compatible adapters. Offer expires September 30, 1988.\*

Trade in IBM for more flexibility. Or trade in Irma<sup>TM</sup> and other brands for more power and IBM compatibility.

Interested? Call us toll-free for details.

1-800-426-6283

#### **Attachmate**

Quality Micro-Mainframe Solutions

Attachmate Corporation 13231 S.E. 36th St. Bellevue, WA 98006 (206) 644-4010

\*Trade-in value based on Attachmate list prices. Other restrictions may apply.

IBM is a registered trademark and PS/2 is a trademark of International Business Machines Corporation. IRMA is a trademark of Digital Communications, Associates

CIRCLE NO. 165 ON READER SERVICE CARD

# MASTIN

#### MKS Awk: Small Language with Big Power.

A terse, easy-to-learn programming language for your PC, MKS **Awk** is an indispensable tool for any programmer from novice to expert.

Based on pattern-matching and C-like actions, MKS **Awk** allows you to manipulate files for retrieval, transformation, reduction, and validation of data.

The first version of UNIX<sup>®</sup>-based **awk** for the DOS environment, MKS **Awk** has an established track record of reliability and flexibility.

Buy MKS **Awk** and be fully compatible with the functionality described by Aho, Kernighan, and Weinberger in their recent book, *The Awk Programming Language*.

MKS Awk:

\$75.00

MKS **Awk** plus *The Awk Programming Language*:

\$89.00

Within continental U.S.A. call:

1-800-265-2797

Elsewhere: 1-519-884-2251

MKS is a trademark of Mortice Kern Systems Inc







#### IEW/WS

The flow-expression report lists components in data-flow diagrams including source, destination, and content. The report can be run for a specific data flow or data store in a dataflow diagram, or it can be run for all objects in an object list. The report prints the name, source, destination, content, and/or processes that act upon or are involved with a data flow. Selection criteria for this report allow the developer to list only certain objects in the data-flow diagram, objects that match all or part of the name specified, or a combination of the two types of objects.

#### A GRAND DESIGN

The design phase of software development involves translating logical models created in the analysis phase into physical components describing how the system will actually function. The developer uses outputs from analysis—entity-relationship diagrams, data-flow diagrams, decomposition diagrams, action diagrams, and reports—to generate actual database or flat-file definitions (those not involving hierarchical relationships), and action diagrams and structure charts, which translate into database schemas or table definitions and program code.

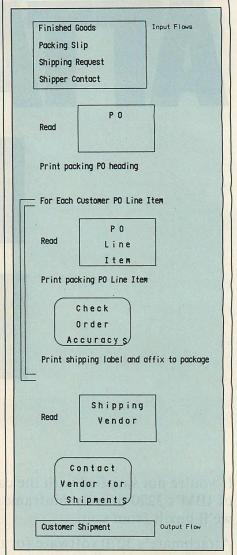
Relationships among diagrams in the design workstation are shown in figure 5. At the top level, structure charts show the hierarchical organization of the modules that comprise a system and the calls and parameters between two modules.

Module-action diagrams (which can be stored in the module library) detail the procedural logic of each module—how program routines function and which actions occur at each level in the program. Using a screen-layout diagrammer, the developer can design screens associated with these modules so the end user can visualize how screens will function in the completed system and approve them prior to coding.

The structure of all data used in a module is detailed using data-structure diagrams, which are tables that list attributes or elements comprising a physical entity in columns. KnowledgeWare leans toward corporate systems in its extensive facilities for designing IMS databases; however, IEW/WS also provides diagramming tools for designing relational and file databases.

Database diagrams depict how file structures are implemented and which relationships exist among the different entities in the database. The design

#### FIGURE 4: Action Diagram



Each step in the Ship Products process is detailed. Double brackets mark a repetition block; rectangles show access to data stores (rounded ones refer to other sequential processes).

workstation provides IMS databasedescription diagrams and textual descriptions as well as flat-file, programspecification-block, and relational diagrams. Each diagram consists of logical records drawn as rectangles, with relationships indicated by arrowed lines connecting them.

For developers anticipating COBOL as their primary application-development language, the design workstation offers the ability to generate COBOL structures from some diagramming tools. By supporting tools to help automate the design and generation of IMS data structures, this workstation can benefit developers in large MIS organizations using the IMS database management system.

# A Graphic Portrayal of Carbon Copy Plus



CGA EGA VGA MCGA

#### Presenting version 5.0 with universal graphics translation

Carbon Copy Plus, the leader in remote control software, has just made interactive graphics easier than ever. That's because our new universal graphics translation lets incompatible graphic formats speak the same language.

#### A New Perspective on Productivity

Carbon Copy Plus makes CGA, EGA, VGA, Hercules™ and MCGA graphics formats compatible, allowing two distant users to interactively view and modify the same images. So now, you can jointly work on a CAD diagram, a Lotus 1-2-3™ graph, or a desktop publishing layout with an associate across the country without duplicating his graphics configuration.

#### **Graphics Plus Remote Control**

Of course, our new graphics features only enhance our other remote control capabilities, which include remote program operation, remote LAN access, remote printing and much more. And since Carbon Copy Plus also gives you remote control over a wide variety of DOS-compatible text, graphics, spreadsheets, databases and other application programs, it could be one of the most productive PC programs you'll ever use.

#### Remote Training, Support and Product Demonstrations

So whether you want to remotely operate your office PC from home, or train and support remote users without leaving your office, Carbon Copy Plus has all the features you need. Call us today and we'll give

you a new perspective on productivity.

Carbon Copy plus

#### MERIDIAN TECHNOLOGY INC

A SUBSIDIARY OF MICROCOM

7 Corporate Park Suite 100 Irvine, CA 92714

(714) 261-1199

A separate Carbon Copy Plus is required for each location.
Carbon Copy Plus is a trademark of Meridian Technology.
All other products referenced are trademarks of their respective companies.

Structure charts. The basic programdesign tool is the structure chart, which shows subroutines or functions in a program, calls made to these subroutines, and parameters passed between the main procedure of the program and each subroutine. These diagrams describe tasks, at a fairly detailed level, that occur in a program. Structure charts consist of a sideways C indicating the root procedure, rectangles representing modules or subroutines, solid or dashed arrowed lines representing calls, and short arrowed lines with circles indicating parameters passed between two routines.

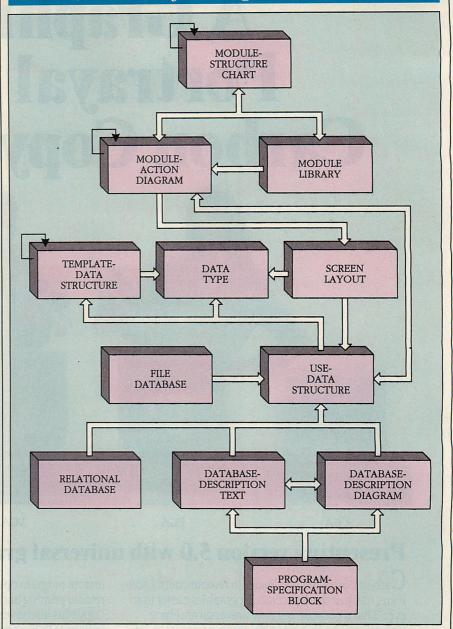
The calling sequence of a module is drawn as a solid line indicating a synchronous call in which control is returned when the called procedure is complete, a dashed line representing an asynchronous call where control is not returned to the calling procedure when it is complete, and double rectangles representing a module that is called recursively. Parameter names are listed next to the lines connecting the routines. The parameters, also known as data and control couples, may be solid (indicating control is passed) or hollow (indicating data are passed between two routines).

Module-action diagrams. Module-action diagrams show individual subroutine logic for modules defined in a structure chart. Parameters passed between two modules in the structure chart may be diagrammed with references to data structures used by them.

Actions appear as blocks of textual instructions, data reads and writes as rectangles with record names, modules as rectangles, data passed between modules as arrow heads, repetition blocks as brackets, and screen displays and reads as rectangles containing a circle. Module-action diagrams can be created from mini-specs, which describe what happens inside a process box. These mini-spec diagrams previously were created with the analysis workstation and may contain references to other action diagrams in the design workstation. In this way, low-level action diagrams, such as read-and-write routines for database records, may be created once and referenced in highlevel action diagrams. Module-action diagrams also can reference screen layouts that, in turn, can represent the actual fields and text displayed in the final program.

**Screen layouts.** The screen-layout diagrammer allows the developer to create images of actual screens to be displayed in the final system. Layouts

FIGURE 5: Overview of the Design Workstation



Relationships among modules in a system are shown hierarchically in the module structure chart and detailed in the action diagram. Data-structure diagrams detail each data structure referenced in the action diagram, and screen layouts describe each interface screen needed, including text, prompt and data fields. The workstation provides tools for designing relational, flat-file, and hierarchical databases.

are composed of literals, fields, and graphic components. The developer can add text and screen variables, such as field names, anywhere on the screen. A status line shows the current line and column being accessed, and the status of the insert feature (on or off). Screen variables allow data entry and display and can be assigned attributes that designate screen color and intensity. The system can generate COBOL-format statements, including picture clauses and some editing criteria from screen layouts.

The Show Screen option from the Screen Layout menu lets the developer see how the screen will look prior to creating executable code, but the screen cannot perform any functions. Screen-layout reports pinpoint overlapping fields, objects outside screen boundaries, missing field attributes, and missing map parameters.

After completing a screen layout, the developer can generate screen maps to run under CICS or IMS and a report listing any problems or errors in the maps. Developers implementing

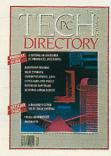
# Complete your Library of PC Tech Journal...

...Order those missing issues today!



#### APRIL'88

PS/2 ONE YEAR LATER—PS/2 Model 80 Type III Product Review; ALR Announces 16and 20-MHL 386 FlexCashe Machines; IBM's Development of Systems Application Architecture (SAA); API Service in DOS 3.3; XBD Systems; C&T and Adapted Disclose PS/2-Compatible Chip Sets; and more.



#### DIRECTORY ISSUE

Complete Editorial Index from Volume 1, Number 1 to present; Listing of Available PC Products Including Expansion Boards, Mass Storage, Communications and LANs, Languages and Tbols, Database Software, and Business Applications; Readers' Guide to PC Tech Journal; Cross-References; Abstracts; and more.



#### OCTOBER '87

ANALYZING NETWORK TRAFFIC—Impressive performance by The Sniffer; Windows Memory Management; Windows Virtual Machine; Btrieve and Xtrieve; MAGIC PC; Gateways to System/8x; three 5251 gateway packages; The Graphics Plus Card; InColor; DOS Memory Control; and more.



#### MARCH'88

PRESENTATION MANAGER— Projecting a graphics interface; The Application Builder (TAB) is a PC/IDMS Alliance; Advanced Revelation; Compaq's Deskpro 386/20; Graphics Development Toolkit for OS/2; New Turbo C; TLIB Version Control and Seidl Version Manager; NETmanager; and more.



#### DECEMBER '87

SPEAKING SQL—The non-procedural Structured Query Language is on its way to providing a universal language allowing different databases to communicate. Plus: Mainframe Migrations—RTT's Ingres and Professional Oracle; Portable 386 from Compaq; 386 from PC's Limited; and more.



#### SEPTEMBER '87

CONFIGURATION MANAGE-MENT—Software tools for tracking code development; Turbo BASIC versus Quick BASIC; Laser Printer Metrics; Simple LAN Alternatives; Refining Mainframe Access; New C++ Language; Underline Fix for the EGA; TopDOS; TASKVIEW; and more.



#### FEBRUARY '88

THE STATE OF C—Professional-level compilers examined; Turbo C; Quick C; PC-Plus; Network Auditing Tools; Memory Architectures; Multiuser Data Managers; Designing Drivers for OS/2, Part II; Quick BASIC strengths and weaknesses; Above Board 2; MultiSync PLUS and MultiSync II monitors; EGA resolution on a VGA; and more.



#### **NOVEMBER '87**

ENTER OS/2—An architecture for the future. Plus: API: High-Level Access Means Flexibility, Multitasking; Microrim: Porting to OS/2; IBM's 9370 Mini-Mainframe; APPC versus NETBIOS; 20-MHz 386 machines from AST, Compaq and IBM; The OS/2 Debate; Updates on Compaq's Deskpro 386 and Deskpro 286; and



#### **JULY '87**

INTELLIGENT GRAPHICS
PROCESSORS—Unprecedented
sophistication for PC graphics;
First look at Intel 82786 and
TMS 34010; LAN-Compatible
Applications; Exploiting the
3270 Connection; and much
more.



#### JANUARY '88

OS/2 ALTERNATIVES—How to decide on an operating system. Includes: Replacing DOS; Enhancing DOS; Merging DOS and Unix. Plus: 386 Add-In Boards; LAN Security Risks; Cobol in a PC Setting; 386 Operating Environments; Redirecting dBASE III PLUS printer output; Quaid Analyzer; DS Optimize; and more.



Other issues are available. For more information, call (609) 354-4975.

# QUANTITIES ARE LIMITED— ORDER TODAY!

Don't leave yourself with gaps in your collection of expert coverage on applications, tutorials, and product reviews from PC TECH JOURNAL. Limited quantities of back issues are available. Please use the attached coupon and enclose \$7 per issue (\$8 per issue for all foreign and Canadian orders, U.S. currency only) and remit to:

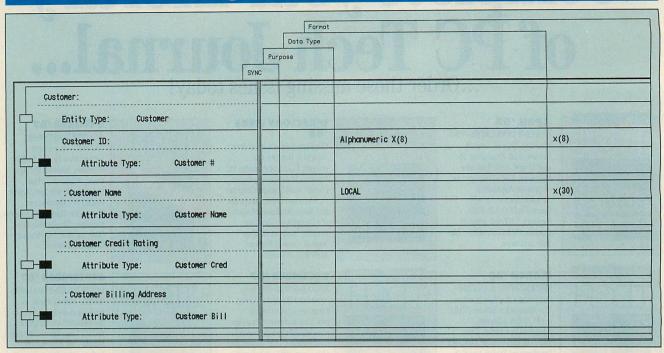
Ziff-Davis Publishing Company P.O. Box 5999 Cherry Hill, NJ 08034 Attn: F. Hunter

Other issues are available. For more information, call (609) 354-4975.

| U.S. currency only):                         | her represent with the ea   |                | citilly manne to indicate an entit   |
|--|---|----------------|--|
| ☐ April '88<br>☐ March '88<br>☐ February '88 | ☐ Directory Issue '88<br>This issue only:<br>\$7.95 U.S.<br>\$9.95 Foreign/Canada |                | □ September '87  |
| ENCLOSED IS \$                               | ODERN ON THE PROPERTY OF THE PROPERTY OF  |                |  |
| NAME   | o name production of the second   | i vina         | and the state of t |
| COMPANY NAME_                                | and the later of remarks  |                |  |
| ADDRESS                                      | and the second of the   | and the second | ar redeposition lectulo set our  |
| CITY   | morel spirel, had almes   | TATE           | Sem ZIP mas order drive anumental  |
|  | ING ISSUES OF PC TECH JOUR<br>dishing Company, P.O. Box 5999, C.                  |                | : F. Hunter  |

Please send me the following issues of PC TECH JOURNAL. I am enclosing \$7 per issue (\$8 in Canada and all foreign countries,

#### FIGURE 6: Data-structure Diagram



Data-structure diagrams describe the object with appropriate property columns. Customer is tied (open rectangle) to the Customer entity type, attributes are tied to the structure (open and filled rectangles), and attribute properties are specified.

the final software on an IBM mainframe using either of these products can upload screen maps and use screen layouts during programming.

**Data-structure diagrams.** In the design workstation, data-structure diagrams describe data elements in individual relations in a relational database, records in a file, segments in a hierarchical database, or screens. Templates are data-structure diagrams used to set up generic data structures for use in different contexts within the system.

Hierarchical data structures are represented in tables. Data structures (fields) are listed in rows and properties of the structure (such as field name, purpose, key type, number of bytes, and data type) as columns across the top of the diagram. In addition to data elements, the left side of the diagram can include double brackets to indicate repeating groups, embedded brackets to indicate optional groups, a small open rectangle to the left of the entity name to indicate an entity tie, one open and one filled rectangle to indicate an attribute tie, and two open rectangles for a relationship tie (see figure 6).

Properties in a data-structure diagram depend on the type of data area the structure represents. Data structures can be global, indicating that no other structure with the same name can exist in the system, or local to a structure,

meaning that the name can be reused elsewhere in the system. Developers can designate a data structure as a field storing data, a pointer to other data structures, or a token to represent an individual entity. Data types also can be assigned to structures representing values the field can contain in the final program. Valid data types are alphabetic, alphanumeric, zoned decimal, single-precision floating point, double-precision floating point, packed decimal, and binary.

Data-structure diagrams can generate COBOL structures in report format that can be exported to external compilers. Data types are mapped to PIC-TURE and USAGE clauses in COBOL data structures. The data types are translated into appropriate COBOL symbols when the report is generated, and editing-format clauses are inserted as required.

**Database diagrams.** Data-structure diagrams are related to the database diagrams they represent, with the exception of templates that do not map to any specific database diagrams.

Flat-file and relational diagrams are used for non-IMS database structures, while IMS database-description diagrams, database-description text, and program-specification-block diagrams are for IMS databases only. The *flat-file diagramming tool* depicts records as rectangles with relationships drawn as

lines connecting records. In *relational-database diagrams*, rectangles represent tables, and the lines connecting them represent relationships among tables. In either tool, relationships can contain cardinalities to indicate the number of occurrences of a record in a relationship, directional arrows to indicate the relationships between two records, and names to depict the type of relationship between two entities.

Database-description diagrams and text can represent physical IMS (hierarchical) database descriptions or logical descriptions. They can be further segregated by the file-access methods used in the physical IMS database. IMS file-access methods include Hierarchical Sequential Access Method (HSAM), Hierarchical Indexed Sequential Access Method (HISAM), Hierarchical Direct Access Method (HDAM), and Hierarchical Indexed Direct Access Method (HIDAM).

Database-description diagrams contain disk (cylindrical) symbols that represent IMS databases, rectangles that represent segments (records) in a database, dotted lines with arrows indicating logical relationships among segments, and solid lines without arrows depicting physical relationships (pointers) among segments. Each segment in the database-description diagram is given a short name, long name, frequency, size, and initial field name.

TABLE 1: Summary of IEW/WS Features

| CASE COMPONENT                    | IEW/WS   |
|-----------------------------------|--|
| Structured diagramming tools      | Decomposition diagrams, data-flow diagrams, action diagrams, entity-relationship diagrams, structure charts, presentation diagrams, data-structure diagrams, flat-file/relational/hierarchical database diagrams, matrix diagrams, and entity diagrams |
| Prototyping tools                 | The design workbench provides a screen-<br>preview capability only.  |
| Repository                        | Encyclopedia   |
| Security controls                 | User IDs and passwords   |
| Access privileges                 | Three capabilities may be granted or restricted: adding new users, changing icons, and changing passwords.   |
| Version control                   | Not available  |
| Multiuser access                  | Not available  |
| Change control                    | Not available  |
| Specification checker             | KnowledgeWare claims that more than 1,000 rules are built into the Knowledge Coordinator component that ensure integrity in the various phases of software development.  |
| Syntax checking                   | Knowledge Coordinator  |
| Completeness checking             | Knowledge Coordinator  |
| Functional decomposition checking | Knowledge Coordinator  |
| Cross-diagram checking            | Knowledge Coordinator  |
| Ability to trace requirements     | Knowledge Coordinator  |
| Links to code generators          | GAMMA, Pansophic's Telon PC  |

The IEW/WS workstations offer most of the features common to CASE tools, including a central repository; tools for producing diagrams useful in planning, analysis, and design; a variety of reporting tools; and links to code generators.

Database-description diagrams do not contain detailed descriptions of their segments. Instead, they are created using data-structure diagrams.

Database-description text files give a complete overview of the database, including database name, access method, password, and size. The file provides each segment's name, number of bytes, parent segment, and any other pertinent information. Details about each field, including its name, number of bytes, and starting position, follow each segment description. Once the database-description text is complete, a report generates all information about the database, which can then be exported to the mainframe.

The program-specification-block tool shows segments in the IMS data-base and the fields used by specific programs. Program-specification blocks contain program-control blocks, which define a subset of segments in the data-base-description diagram to be referenced by the program. Macro instructions that make up the program-control block contain key words and parameters that generate program-specification blocks on the mainframe.

**Reports.** Reports from the design workstation provide analytical information that can help the developer locate and fix potential design problems before a system is implemented. Five reports are run from the diagramming tool on which they report, while a sixth (the unattached-segment report) runs from an object list.

The action-diagram-text report prints the contents of action diagrams selected without brackets or icons. The call-analysis report compares formal parameters of modules with calling parameters passed from higher-level modules. The database-descriptionanalysis report lists the physical database descriptions that are sources for segments in the logical databasedescription diagrams. The moduleanalysis report lists calling-module names, incomplete states, calls, and called modules. The programspecification-analysis report lists the contents of database-description diagrams and segments they represent in the program-specification block. The unattached-segment report lists segments in an encyclopedia that are not referenced in any database diagram.

#### BEANSTALK FOR BIG BUSINESS

IEW/ws lays an impressive path for large-scale systems development (see table 1). Its Encyclopedia capability, Knowledge Coordinator, and GEM interface and its ability to link the three initial phases of software development give it particular power and appeal for large corporations. IEW/ws's ability to display multiple diagrams on the screen through the GEM interface is truly valuable, and the Knowledge Coordinator is unusually powerful in preventing errors when developing complex systems. The Knowledge Coordinator concept is excellent, but in practice it is inflexible because developers cannot see the existing rules and cannot introduce new ones.

While IEW/WS provides many tools for the software developer, the combined cost of all three products and the resources required to run them on a PC can be significant. Priced separately, the workstations are far too expensive for many small PC developers, but the \$10,000 starter package may be attractive. Those unfamiliar with CASE technology can expect to spend some extra time and dollars on training before they come up to speed.

Of all three workstations, the analysis workstation is the most valuable piece for PC developers. While the design workstation offers extremely useful structure charts and action diagrams, the action diagrams are present in the analysis workstation as well. The screen layouts, which could be very useful, unfortunately support only COBOL.

The consummate customers for IEW/WS are MIS organizations already using the information-engineering approach to software development along with IBM mainframe products. They can benefit from IEW/WS by having the luxury of switching development efforts as needed from PCs to a mainframe and therefore significantly increasing staff productivity.

3340 Peachtree Road NE, Suite 2900 Atlanta, GA 30026 404/231-8575 IEW/WS: Start-up package including Planning, Analysis, and Design workstations: \$10,000; one workstation only, or first additional workstation,

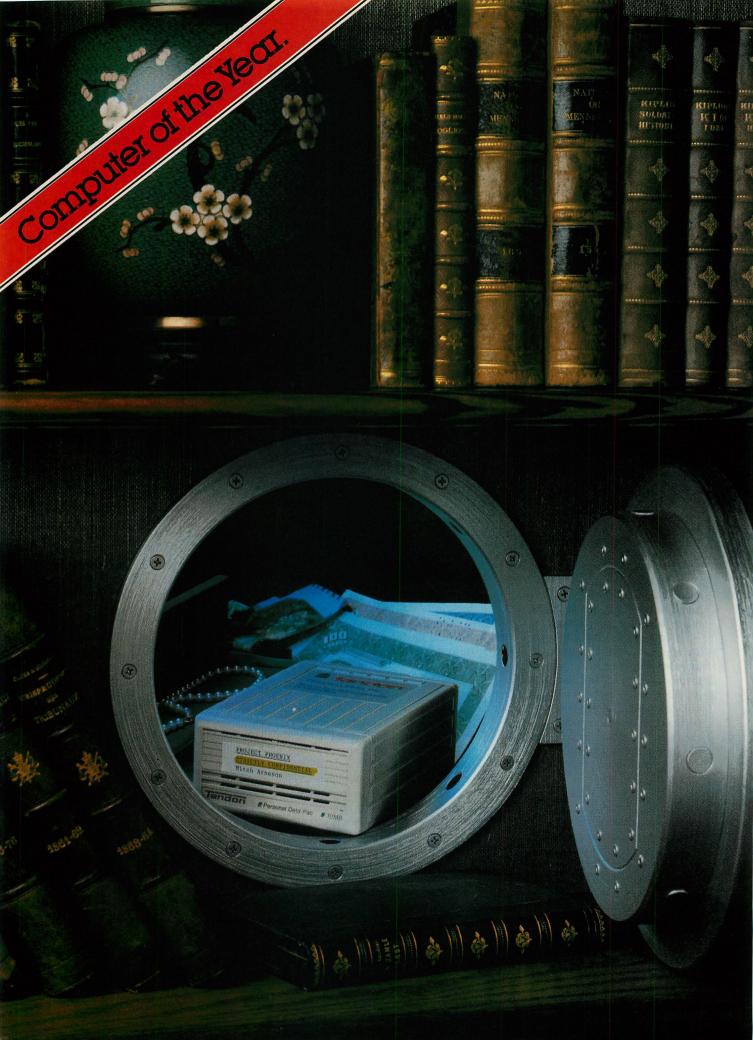
only, or first additional workstation, \$8,600; price decreases for additional workstations.

CIRCLE 337 ON READER SERVICE CARD

KnowledgeWare Inc.

Andrew Topper is president and founder of Foresite Systems, a Michigan consulting firm providing applications development services.

SEPTEMBER 1988 123



# "Secure"

si·kūr, a. [L. securus]: The ability to keep your confidential data and your whole personal computing environment away from prying eyes and meddling associates.

Securing your personal computer files has, until now, been a complicated and mostly unreliable matter. Not any more.

The Tandon Personal Data Pac is the world's first truly removable, self-contained Winchester hard disk drive that pops in and out of its receptacle with the stroke of a key. You just lock the Personal Data Pac with your entire computing environment in your desk or your safe.

And when your business keeps you on the move, the Tandon
Personal Data Pac lets you take your office with you. It fits easily in your brief-

case or your garment bag. If the airlines lose it, don't fret. Backing up a

fret. Backing up a full Personal Data Pac onto another takes only a few minutes. So you can take one and keep a copy secure in your safe.

The Personal Data Pac protects your data well. It's

a hearty little traveller that can take a lot of abuse. It can cope with the rough and tumble world of the postal system, as well as

take an occasional knock off your



desk. Your precious programs and data remain cradled inside. Safe, secure, and ready to use.

The Tandon Personal Data Pac shatters the storage limitations of your personal computer. When your first high-capacity Data Pac is full, pop in a fresh one and you're ready to go on. Infinitely.

If you need to share your PC, software and data, the Tandon Personal Data Pac offers the safest, cheapest and most reliable "network" pos-

by

Pac.

transferring
highcapacity files
quickly and
easily. And, you can
make any computer
your personal dedicated
workstation, simply
inserting your own Data

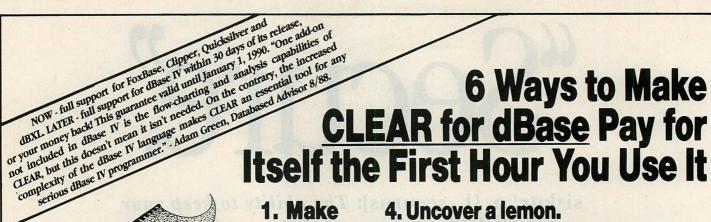
sible for

Let your Tandon Dealer show you how the Personal Data Pac can make living with your PC more economical and productive. See him today, or call us at **1-800-556-1234**, Ext. 171 (in California **1-800-441-2345**, Ext. 171).

Security for a small price.



We're redefining personal computing.



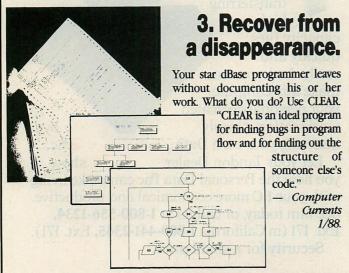
1. Make a sale.

Instead of writing extensive code to show sample screens and reports for your application, you can use CLEAR-generated graphics to show users how your proposed system works as a whole. For example: consultant Pat Adams was asked to bid on a major dBase application. Her proposal consisted 75% of CLEAR-generated diagrams

which she produced in 30 minutes! She won the contract at the first presentation. "When the client saw the CLEAR diagrams, he said: Are we going to get the same kind of documentation when you're finished? When I said Yes, they gave me the contract on the spot at the proposed price."

#### 2. Meet a deadline.

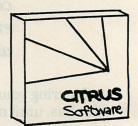
You're managing the creation of a large dBase application. Threequarters through the project, the principal user wants to make "minor" changes. Using CLEAR, you show her — on the spot the non-minor effects of her changes, reach a compromise, and keep your project on track.

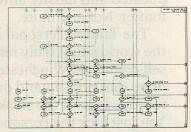


#### 4. Uncover a lemon.

You are evaluating office-management systems for your fast-growing business. One package, written in dBase, has all the features you want. But after you run the source code through CLEAR, it is obvious that the program will never keep up with your fast-changing requirements - the code is so poorly structured that you will never be able

to modify or maintain it. "CLEAR can make the structure of a program so obvious that it can save days of reading listings and of taking guesses at what a section of code does." - Computer Currents 2/8/88.





#### 5. Kill a bug.

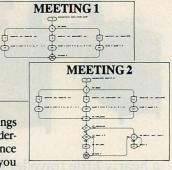
dBase programs can quickly become convoluted. By looking at the big picture, you can immediately understand where to look for a bug - and you can prevent major bugs from ever being born. "The ability to step through flowchart decision nodes of your program as you write it makes CLEAR for dBase an important debugging and development tool. You can identify logic errors before you write major sections of code; you can use the flowcharts and tree charts for presentations of system logic well in advance of actual coding."

— PC Magazine 2/16/88.

#### 6. Shorten meeting.

Before CLEAR, your dBase programming team would spend

60% of its project meetings making sure everyone understood the changes made since the last meeting. Now you



simply compare 2 CLEAR diagrams, and everyone is up to date in minutes.

Published by: CLEAR Software, Inc. 637 Washington Street, Brookline, MA 02146

|                            | List<br>Price | PS<br>Price |
|----------------------------|---------------|-------------|
| CLEAR for dBase            | \$99.95       | \$85.00     |
| w/HP Laser & 24-pin option | \$150.00      | \$125.00    |

Please add \$5 S&H in US, \$15 abroad.

Requirements: 512K RAM, IBM PC/XTK/AT; 2 360K floppy drives or 1 floppy + 1 hard drive; CGA, EGA, VGA, or Hercules for screen display.

# PRODUCT WATCH

Reviews and Updates



#### FASTBACK PLUS 1.0

Fifth Generation Systems Inc.



#### MKS TOOLKIT 2.3

Mortice Kern Systems Inc.



PRO-C 1.1
Chancelogic Inc.

# FASTBACK PLUS 1.0 Fifth Generation Systems Inc. 11200 Industriplex Blvd. Baton Rouge, IA 70809 504/291-7221 PRICE: \$189

ith Fastback Plus, Fifth Generation Systems has produced a sequel to an already powerful product (see "Backup Utility Performance," Steven Armbrust and Ted Forgeron, March 1986, p. 78, and "Sleek Backup," Jeff Duntemann, October 1985, p. 31). The most significant enhancements in this release include the use of standard DOS format for the backup diskettes, the ability to change options without reinstallation, and the incorporation of macros.

CIRCLE 338 ON READER SERVICE CARD

The installation procedure merely copies the files from the distribution disk to a specified subdirectory on the hard disk. Setting the system configuration, such as the number and type of diskette drives and which DMA speed to use, is no longer automatically done at installation, but is one of the operations chosen from pull-down menus.

The configuration may be set at any time; it is not necessary to run hardware tests at each change as it was with the previous version. The new procedure especially is convenient when reinstalling Fastback on a newly reformatted disk in preparation for running a restore. With the old version, the user could not establish the previous configuration parameters without running full hardware tests; with the new version, the user simply can copy the Fastback Plus files, set the system configuration without hardware testing, and immediately begin restoring.

Fastback Plus's pull-down menus allow both the novice and the experienced user to back up and restore files without having to memorize anything. The context-sensitive Help feature is particularly useful for beginners. In fact, one of the choices on the Options menu is user level: beginner, experienced, or advanced. Besides establishing the help level, each setting opens up access to a different set of features.

The acid test for any backup system is backing up a failed hard disk. In testing for this review, Fastback Plus saved every file that could be saved using other methods (such as Norton Utilities and the DOS BACKUP and COPY \*.\* commands) and ended cleanly when it was unable to recover any more files.

Through the menus, standard DOS wild-card protocol can be used to include, exclude, and then select files by date to back up. These options go beyond the simple backup-by-date-ordirectory choices found in many backup programs. While the backup is running, the user is kept constantly informed about the progress of the backup as the files and directories scroll up the right-hand side of the screen. At the same time, on the lefthand side of the screen, a pattern of diamonds blinks and changes to show buffer usage—an interesting, but not very useful, display.

Fastback Plus performs three types of backups: full, incremental, and differential. The first type, full backup, copies every selected file and turns off

its archive bit. The second type, incremental backup, copies only changed files and resets their archive bits; the resulting backup set contains only those files that have changed since the last incremental backup. Restoring a disk to its latest state requires restoring from the latest full backup, then restoring from each succeeding incremental backup. The third type, differential backup, copies only changed files and leaves the archive bits on. It contains the latest files that have changed since the last full backup, so recovering a disk involves restoring from the last full backup set followed by restoring from the latest differential set.

The backup disks are written in DOS format, allowing the use of the DIR and CHKDSK commands to check the date, time and integrity of the backup files. The DIR command, however, shows only one file per disk, taking up the entire disk space. Within this file, Fastback Plus maintains its own proprietary data structures, using compression to save space and error-correction codes for integrity.

When do you need to restore a hard disk? The most urgent time, of course, is after the hard disk crashes and you need to move your data to another computer. Two Fastback Plus restore options cover this eventuality. One option is to restore data under the same directory structure as the old disk; the second option is to restore data under a subdirectory on a new disk. If you choose the second method, all files are stored under the same directory. Although not available with Fastback Plus, it would be extremely helpful to be able to restore your hard disk on another computer under one subdirectory while retaining your original directory structure.

Considering all of the other types of programs now available that have their own macro languages, why not a backup program, too? What at first ap-

SEPTEMBER 1988 127

pears to be overkill becomes almost indispensable when Fastback Plus performs automatic backups from within application programs. For those who are responsible for helping users of all levels of computer literacy use proper backup guidelines, telling a user to "type FB @WED on Wednesdays and FB @FRI on Fridays" is much easier than spelling out all the steps involved in running incremental backups versus full backups.

Macros can be created three ways. The easiest way is to navigate the menus and set all options (such as disk type, incremental, or complete backup) and save them as a setup file with the F10 key or the menu option. The second method is to choose the "Advanced user level" and then "Record keystrokes" from the menu, perform the actions desired followed by pressing the F7 key. Finally, macro files also can be created using a file editor.

Like most software publishers, Fifth Generation chose nonstandard macro keys to represent those characters that do not normally print. For example, the Enter key, a left (or open) parenthesis mark in Fastback Plus macros, is represented by a tilde, vertical rule, or a multicharacter string such as <CR > in other macro programs. It would be helpful if software publishers got together and agreed on one set of macro symbols.

Because Fastback Plus is easy to use, the temptation is great never to read the manual. Chapter 5 ("Backup Basics"), however, should be required reading for all new hard-disk users. Written in glossary style, the section is an efficient recap of the terminology of and reasons for backups. More advanced users probably will need to read the manual for information on constructing and using macros.

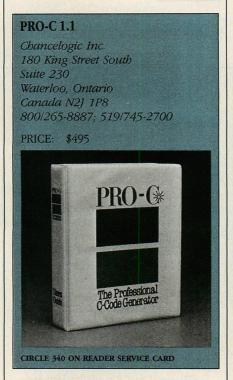
Fifth Generation efficiently maintains backward compatibility by providing a menu option in order to run the old Fastback FRESTORE program.

FRESTORE is not included with the new release, so keep the disks with the original Fastback program.

During testing, Fastback Plus operated without problem on the IBM PC, PC/XT, and PC/AT, a Compaq Deskpro 286, and a Standard 286/10 AT compatible. The option-setting program failed the high-speed DMA test, however, on the 16-MHz Compaq Deskpro 386. When the DMA speed was set to high through the "set DMA speed" option in the installation menu, the program worked flawlessly.

Given the value of the work stored on the hard disk of an individual's computer, almost any backup program is worthwhile insurance. Because of its unique features and its ease of use, Fastback Plus 1.0 is a cut above most programs and is recommended for both novice and expert.

-R. MARTIN TEMPLE



s with any professional, time is money to a software consultant. The time needed to rewrite routine source code quickly eats into the profits from a programming contract. For this reason, many software consultants eventually buy or write their own program generators.

The idea behind a program generator is simple: let the computer write the mundane code—including programs for file maintenance, menus, reports, and documentation. The Pro-C program generator from Chancelogic does all this and more, generating C program source code for a variety of commercial compilers.

Pro-C 1.1 is a ruthlessly menudriven and consistent program generator. The Esc key always exits a function, the F1 key always supplies help information, and the Enter and Tab keys move forward and backward between fields. Some of the menus are pop-up, while other menus use a highlighted bar to select functions. The program's monochrome text on a black screen, however, is rather outdated.

The package is installed by copying the six diskettes to a hard disk and running an install program to build empty subdirectories for the generated files. As part of the installation process, Pro-C prompts for the C compiler that will be used. Lattice MS-DOS C 3.2, Borland Turbo C 1.0, and Microsoft C 4.5 all appear on a list of supported compilers. Microsoft C 5.0, which is now available, is listed ominously as a "future" compiler. Fortunately, the C code and libraries are not too versionspecific; for this review, Turbo C 1.5 was used, and the compiled code worked flawlessly. Chancelogic says that it is completing an update for the most recent versions of these compilers.

Pro-C designs and generates files, menus, screens, and reports-all individual items on the program's main menu. The first task in most projects is to design the files because the other programs are generated using this information. File design consists of defining the records and fields that the file will contain. Unlike some program generators that use proprietary file access methods, Pro-C generates code for Softcraft's Btrieve, FairCom's C-Tree, and Relational Database System's C-ISAMall popular commercial libraries. In this version of Pro-C, only indexed files are supported, but this is not really a restriction because this type of organization is the most popular.

A self-designed file manager can be used, but the interface required is documented only sketchily in the help files and not at all in the manual. A call to Chancelogic helped to clarify the interface. Pro-C has its file modules numbered from 1 to 9. Files 1, 2, and 3 are C-ISAM, Btrieve, and C-Tree, respectively; file modules 4 through 8 are user-defined; and file 9 is ASCII. To use the file modules, a programmer must create a file called IOx.C, where x is the number of the module to be used. The file contains a set of 11 routines to open and close the data files and their indexes, to retrieve records by exact or partial key, and to add, delete, or update records. No source code for any of the already-defined interfaces is provided to use as a template, but the calling sequences for these functions are found in the C source code that Pro-C generates. As indicated in the help file, only experienced C programmers should attempt this.

Pro-C requires that every file contain a unique primary key. Up to seven alternative keys also may be defined. A field contains up to 76 characters (a

#### PRICED TO SAVE, SHIPPED FAST!!!

#### FRONTRUNNER (a new Ashton Tate product created by Apex Software)

FrontRunner generates memory-resident pop-up applications using the dBASE III Plus or dBASE IV programming language. Once your memory-resident program is created, pop-up your program while using Lotus 1-2-3, any dBASE program, Clipper, Basic, any word processor, DOS or any program written in any language. Pop-in and Pop-Ont of any software backage instantly. All Out of any software package instantly. All data files and indexes created are dBASE compatible. FrontRunner applications can be compiled into binary files for protected distribution and unparalleled

speed. The user selects a hot-key to call up an application. Use the unique POWERKEY feature to define additional hot-keys within the application. A power-ful paste command allows the user to extract data from a FrontRunner application into a word processor, spreadsheet or other application. Use FrontRunner for pop-up help screens, account listings, phone directories, schedules, random notes, printing mailing labels.... anything

FrontRunner....List: \$295, Ours: \$195 (new low price!)

#### GREENLEAF LIBRARIES

#### **Functions**

C source, assembler source, and binary libraries of 225 functions for many compilers. Emphasizes tight functional groupings to minimize loading code which your application may never use. Manual's 250 pages help select functions, as do demos, bulletin board.

#### Communications

Communicate from within your own C programs! Over 120 functions and demo programs in C and assembler source to set up interrupt-driven asynch communications for up to 16 channels. Up to 9600 baud, ASCII or binary, any parity or word length, 8250 UARTs, Xon/Xoff and Xmodem, WideTrack receive. Goodbye separate communica-tions software. Specify compiler.

#### Data Windows

DC

Windows, menus and data entry do work together...when you utilize Green-leaf's screen architect. This smooth screen designer offers device independence, logical windows, table driven data entry and economical pricing. Source code is also available.

| communications                      |       | Ours<br>\$139  |
|-------------------------------------|-------|----------------|
| unctions                            | \$185 | \$139          |
| ata Windows<br>complete 3 in 1 Pack |       | \$249<br>\$475 |

#### Shopping List for the Power Workbench

| Application of the property and the second                                       |            |            |  |            |            |   |                                  |
|--|------------|------------|--|------------|------------|---|----------------------------------|
| ASSEMBLER  | LIST       |            |  | LIST       |            |   | LIST US                          |
| Microsoft Macro Assembler with Utilities .                                       | 150        |            | C Food Smorgasbord by Lattice  | 150        |            | Brief & dBrief Combo  | 275 219                          |
| PASM 86 by Phoenix, Macro Assembler  | 195        | 109        | C Utility Library by Essential,300 functions   |            |            | Condor EditorCondor Corp SUPER SALE                                       | 130 65                           |
| ASSEMBLER Support  |            |            | Greenleaf Functions  |            |            | EpsilonLugaru   | 195 149                          |
| Btrieve Softcraft's File Manager   |            | 175        | PforCe by Phoenix, vast library  | 395        | 199        | KEDITMansfieldidentical to XEDIT  | 125 99                           |
| GSS CGIDevice independent graphics   | 495        | 425        | OTHER TOOLS  |            | dence      | KEDIT Ver. 4.0  | 150 119                          |
| BASIC  |            |            | BASTOCJMI, Translates BASIC to C   |            |            | PmatePhoenix  | 195 109                          |
| Microsoft BASIC Interpreterfor XENIX Microsoft QuickBASIC Ver 4.0                |            | 249        | dBX TranslatordBASE to C translator  | 550        |            | Vedit PlusCompuview   | 185 129                          |
| Microsoft QuickBASICVer 4.0  | 99         | 66         | with Library Source Pre/Cby Phoenix, like UNIX lint  | 950<br>295 |            | DEBUGGERS   |                                  |
| Turbo BASICNEW from Borland  | 100        | 75         | PC-LINTby Gimpel, subset of UNIX Lint  | 139        |            | Advanced Trace 86Morgan   | 175 119                          |
| BASIC LIBRARIES & UTILITIES  |            |            | and the second of the second o | 100        |            | C-SpriteSource debugger for Lattice C                                     | 175 139                          |
| Btrieve Softcraft's File Manager   | 245        | 175        | Miero Feerra COROL /2  | 900        | 795        | Periscope IBoard, Switch, Software Periscope IIBreakout Switch & Software | 345 <b>289</b> 175 <b>139</b>    |
| GSS CGIDevice Independent Library  | 495        |            | Micro Focus COBOL/2  | 900        |            | Periscope IISoftware only   | 145 105                          |
| Halo Graphics by Media Cybernetics   | 325        | 249        | Micro Focus Personal COBOL   | 149        | 134        | Periscope III8 Mhz  |                                  |
| C LANGUAGE COMPILERS   |            |            | Microsoft COBOL inc. COBOL Tools   | 700        |            | Periscope III10 Mhz   | 1195 975                         |
| C86 PLUS by Computer Innovations   | 497        | 397        | for XENIX  | 995        |            | Pfix 86 PlusPhoenix symbolic debugger.                                    | 395 199                          |
| Lattice C Compiler Now ver 3.2   | 450        |            | RM/COBOLby Ryan McFarland  | 950        |            | LOGITECH  |                                  |
| Let's C Compiler from Mark Williams Co Mark Williams C full development system . | 75<br>495  | 55<br>369  | RM/COBOL 85ANSI 85   | 1250       | 895        | MODULA-2 Compiler Package   | 99 79                            |
| Microsoft C Compiler with free CODEVIEW  | 450        | 295        | COBOL Support  |            |            | MODULA-2 Development Pkg  | 249 199                          |
| Microsoft QuickCSpecial Price  | 99         | 66         | Btrieve Softcraft's File Manager   |            |            | MODULA-2 Toolkit  | 169 139                          |
| Turbo CNew from Borland  | 100        | 75         | GSS CGIDevice independent graphics   | 495        |            | MODULA-2 ROM Package  | 299 239                          |
| C LIBRARIES—Communications   |            |            | Halofrom Media Cybernetics   | 325        |            | MODULA-2 Window Package   | 49 39                            |
| Asynch Manager by Blaise   | 175        | 135        | RM/ScreensScreen generator   | 395<br>300 |            | PHOENIX   |                                  |
| Greenleaf Communications   | 185        | 139        | The state of the s | 300        | 245        | Pasm 86 Macro ASSEMBLER   | 195 109                          |
| Essential Communications   | 185        | 125        | DBASE & RELATED PRODUCTS   | 200        | 040        | PdiskDisk Management Utility  | 145 95                           |
| Essential Communications Plus  | 250        | 189        | Applications PlusFox & Geller<br>Brief & dBriefEditor/Macro lang for DBase   | 299<br>275 |            | PFantasysix-pack take-away  | 995 569                          |
| C LIBRARIES—FILE MANAGEMENT  |            |            | ClipperNantucket's DBase Compiler  | 695        |            | PFinishProfiler PFix 86 Plus.Symbolic Debugger                            | 395 <b>199</b><br>395 <b>199</b> |
| Btrieve Softcraft's File Manager   | 245        | 175        | DATA-pWallsoft   | 60         | 50         | PForCeUtility library   | 395 199                          |
| Btrieve/N File Management for Networks.  | 595        | 445        | dBC III Plus supports multiuser commands   | 750        |            | PforCePforce for C  | 395 199                          |
| Ctree by Faircom, with full source   | 395        | 299        | with Source code   | 1500       |            | PLink 86+sophisticated overlay linker                                     | 495 269                          |
| RtreeReport Gen. for Ctree   | 295        | 235        | dBC ISAMaccesses dBase files   | 250        |            | PMakermake utility  | 125 74                           |
| Ctree & RtreeSpecial Combination   | 650        | 499        | with Source code   | 500        |            | PmateText Editor  | 195 109                          |
| dBC ISAM Accesses dBase files  | 250        | 175        | dBX TranslatordBASE to C translator  | 550        |            | Pre-CSuper-set of UNIX Lint   | 295 154                          |
| with Source code   | 500        | 349        | with Library Source dFlowWallsoft  | 950<br>149 |            | PtelBinary Transfer Program   | 49 39                            |
| dBC III Plus multiuser with Source code  | 750        | 595        | DocumenterWallsoft   | 295        |            | POLYTRON  |                                  |
| Opt Tech Sort Super fast sort for Btrieve  | 149        | 105        | FoxBase+Fox Software   | 395        | 219        | PolyBoostSoftware accelerator   | 80 64                            |
| XQLSQL from NOVELL   |            | 595        | Multiuser version  | 595        | 349        | PolyDesk III3rd Generation Desktop org                                    | 99 73                            |
|  | 274 (12)   | ATTE       | QuickCode PlusFox & Geller   | 295        |            | PolyLibrarianLibrary Manager  | 99 89                            |
| C LIBRARIES—Graphics Essential Graphicsno royalties                              | 299        | 225        | QuickEntryFox & Geller   | 99         | 59         | PolyLibrarian II  | 149 129                          |
| GSS CGI Device independent graphics  | 495        | 425        | QuickReportFox & Geller  | 295        |            | PolyMakeComplete MAKE Utility PolyShellUNIX-like Command Shell            | 149 <b>129</b> 149 <b>109</b>    |
| GSS Metafile Interpreter stores images   | 295        | 265        | UI ProgrammerWallsoft  | 295        | 244        | PolyXREF2Cross Reference Util all lang.                                   | 219 169                          |
| Halo '88 by Media Cybernetics  | 325        | 249        | FORTRAN Compilers & Utilities  |            |            | PolyXREF2Single Language support  | 129 99                           |
| Halo for Microsoft Languages   | 595        | 434        | Btrieve: Softcraft's File Manager  | 245<br>495 |            | PVCS CorporateSource Code Control   | 395 329                          |
| C LIBRARIES—Screen Design  |            |            | GSS Graphics Development ToolkitCGI GSS GKSKernel Sys, ANSI Level 2b   | 495        |            | PVCS PersonalPersonalised ver of above                                    | 149 129                          |
| Curses from Lattice, UNIX lookalike  | 125        | 99         | Halo '88from Media Cybernetics   | 325        |            | PVCS NetworkPowerful Ver. of PVCS   | Call Call                        |
| with source  | 250        | 199        | Microsoft Fortran Ver 4.0,inc. Codeview  | 450        |            | RYAN McFARLAND  |                                  |
| C Worthyby Custom Design Systems   | 195        | 159        | for XENIX  | 695        | 499        | RM/COBOLANSI 74 Standard  | 950 675                          |
| C Worthy with Forms  | 295        | 269        | R/M FortranANSI 77 by Ryan McFarland.  | 595        | 425        | for UNIX or XENIX   | 1250 999                         |
| Greenleaf Data Windows   | 295        | 225        | for XENIX  | 750        | 599        | RM/COBOL 85ANSI 85 Standard   | 1250 895                         |
| Microsoft Windows Dev. Toolkit   | 500        | 365<br>395 | Spindrift LibraryBy Spindrift Labs   | 149        | 129        | RM/FORTRANANSI 77 Standard  | 595 425                          |
| View Manager for C,Blaise  | 495<br>275 | 199        | PROLOG   | 0.5        | COLUMN THE | for UNIX or XENIX   | 750 599                          |
| Vitamin CCreative Programming  | 225        | 198        | APT. PROLOG Tutor  | 65<br>650  | 59<br>569  | RM/NET+5COBOL Networking RM/ScreensCOBOL 85 Screen generator              | 300 <b>249</b><br>395 <b>335</b> |
| VC ScreenSource code Generator   | 100        | 81         | Arity PROLOG Compiler & Interpreter Arity PROLOG Interpreter   | 295        | 229        |   | 333                              |
| Windows for C  | 195        | 149        | Arity Standard PROLOG  | 95         | 77         | SOFTCRAFT   | der der met                      |
| Windows for Data   | 295        | 259        | PROLOG-86 PlusSolution Systems   | 250        | 199        | Strieve Softcraft's File Manager  | 245 175                          |
| ZviewData Management Consultants   | 245        | 175        | Turbo PROLOGBorland Intl   | 100        | 75         | XtrieveQuery language for Btrieve Report Option for Xtrieve               | 245 <b>220</b> 145 <b>128</b>    |
| C UTILITY LIBRARIES  |            |            | Turbo PROLOG ToolboxBorland  | 100        | 75         | Btrieve/N File Management for Networks                                    | 595 445                          |
| Basic CBasic-like routines for C   | 175        | 139        | TEXT EDITORS   |            |            | Xtrieve/NMulti-User Query   | 595 459                          |
| Blaise C Tools Plus/5.0f/MsC & QuickC  | 129        | 99         | Brieffrom Solution Systems   | 195        | 155        | Report Option/NMulti-user Rep Opt   | 345 269                          |
| Blaise Turbo C Toolsf/Turbo C  | 129        | 99         | dBriefMacro lang for Brief & DBase   | 95         | 75         | XQLSQL for Btrieve  | 795 <b>595</b>                   |
|  |            |            |  |            |            |   |                                  |

150 FIFTH AVE., NEW YORK, NY 10011-4311 PHONE: 212-242-3600







#### PROGRAMMING PRODUCTIVITY TOOLS

#### ESSENTIAL C UTILITY LIBRARY

#### 400 Functions, 30¢ Each

You've probably seen the speed and power of Essential's C function library without knowing it. Software greats have been using it for some time to give to-

day's top products pizazz and panache. Now grown to 400 functions Essential produces pop-up menus, save and restore screens and windows to disk or memory in as little as 1/10th second, and the fastest video output available. Library has a complete set of 50 business graphics functions, 40 string handlers, 28 functions for printers, 18 for mice, 11 for time and date. DOS interfacing functions offer disk error trapping directory and file management. Every-thing in source, including sample pro-grams that demo library functions. We have versions with pre-built libraries for all well-known C compilers, and a source code librarian is supplied for rolling your own

|                          | List: PC | Expres |
|--------------------------|----------|--------|
| C Utility Library        | \$185    | \$119  |
| Essential Graphics       | \$299    | \$225  |
| Essential Communications | \$185    | \$125  |
| with Breakout Debugger   | \$250    | \$189  |

#### **C-TREE & R-TREE**

#### B-Tree File Manager Now Has Report Generator

c-tree: The only major b-tree file manager with network support in the standard low-cost version. c-tree<sup>TM</sup> gives you recordlocking routines for DOS 3.1/3.2, UNIX and XENIX, and it even comes in C source code, yet there are no royalties. Source sticks to K&R, so c-tree is portable. Tests in many environments prove it.

Permits any number of keys for a data file—alpha, numeric, even floating point. Handles files with varied record lengths, multiple keys in one index file. Both high level and decomposed functions. It's the

r-tree: Adds the ability to produce ad hoc reports from files maintained by c-tree (v. 4.1 and up). Link a file description to the r-tree<sup>TM</sup> library, and use any text editor to write report scripts with no further C coding. Reports can access data in several files, select on criteria, join findings into new logical records, sort them, calculate new fields and columns, tabulate by control breaks. Comes in source, same portability as c-tree, and fits any compiler.

#### r-tree: \$295 \$235

Ours

Combined:

\$499

#### **WINDOWS** for DATA

\$395

c-tree:

#### M'soft Windows Compatible

Onlt one package can be easily recommended" said Computer Language (June 87) reviewing nine window and data entry products for C. Complete field level functions specify prompt string, field length, data type, screen location, picture, target wishble posters and polymers and produced to the produced strip and produced to the produced strip and produced to the produced to the produced strip and produced to the produc variable, entry rules, help messages, even functions to call for validation once

data keyed in.
Windows for C is a subset. No data entry but all windowing functions. Unlimited windows can be made either to pop up or permanently overwrite the screen, scroll and highlight lists vertically and horizontally. Specify Compiler. Windows for Data: List \$295, Ours \$259. Windows for C: List \$195, Ours \$149.

#### BLAISE C TOOLS PLUS/5.0

TOOLS PLUS/5.0 from Blaise Computing Inc. helps you to quickly build professional applications using the full power of Microsoft C 5.0 and QuickC. Now you can concentrate on program creativity by having full control over DOS, menus, interrupt service routines, memory resident programs, fast direct video access; windows; printer and key-

board control, and more!

Blaise Computing's attention to detail, Blase Computing s attention to decial, like the use of full function prototyping, cleanly organized header files, and a comprehensive, fully-indexed manual, makes C TOOLS PLUS/5.0 the choice for experienced developers as well as new-

comers to C.

C TOOLS PLUS/5.0 prebuilt libraries are ready to use with either QuickC or the Microsoft C 5.0 command line environment, Complete documented source code is included so that you can study and adapt it to your specific needs.

|                   | List: I | C Expres |
|-------------------|---------|----------|
| C TOOLS PLUS/5.0  | \$129   | \$ 99    |
| Turbo C TOOLS     | \$129   | \$ 99    |
| CASYNCHMANAGE     | R\$175  | \$135    |
| Turbo POWER TOOLS | S \$ 99 | \$ 75    |
| Turbo ASYNCH PLUS |         | \$ 75    |

#### PANEL PLUS Library Source Code Gives It Complete Portability

There are no end of tools for screen design and data entry, but none quite like Panel Plus. Design a screen under program control, use Panel's utility to "run" and test it field by field, then pass it to Panel's code generator which delivers C source code. Options style the code to your compiler's liking, and you can of course do what you like to the source afterward. The code calls Panel Plus's function library, but now the library comes in source, so every thing produced is highly portable. Not like other screen managers delivered as object libraries and which leave you to write the detailed code.

Panel Plus will operate in graphics mode via interfaces to graphics products it supports and can utilize the EGA's 43-line screen. Low-level I/O functions adapt it to various keyboards, screens, operating systems.

Panel's newest incarnation has every imaginable feature. A single screen design can have 1000 fields stacked as visual overlays up to 127 levels deep or

as pop-ups. Groups of fields can be moved between levels. Screens can be output as compilable code or stored on disk for loading at run-time. Each field can be boxed, colored, multi-row, wordwrapped, and scrolled horizontally and vertically if larger than its on-screen view aperture. It can be assigned its own help and error message, can be told to accept certain characters, or to natch a picture, and to check data after entry—proper dates, number ranges, etc.—using Panel's or your own validation routines. You can add your routines to Panel's test utility because even it comes as source. Fields are accessed in any order and control reverts to your application program after each

field for choice of action.

For past Panelists, the new version has smaller and faster field and screen functions, tighter granularity, and an en-hanced, reworked library. Major tool for the serious developer. List: \$495,

PC Express: \$395.

#### POLYTRON VERSION CONTROL

#### Source Code Control for Any Language

PVCS allows programmers, project managers, librarians and system administrators to control the proliferation of revisions and versions of source code in software systems. Independent programmers, the leading soft-ware publishers and LAN companies, and hundreds of Fortune 1000 com-panies rely on PVCS to store and re-trieve multiple revisions of text. It maintains a complete history of revisions as an "audit trail", generates status reports, and uses intelligent "difference detection" to minimize disk space for each new version.

On Corporate and Network PVCS simultaneous changes to a module are merged into a single new version. If changes conflict, the user is notified

The "Logfiles" used to track changes are interchangeable between any PVCS product

Corporate PVCS is for multiple programmers. It includes "branching grammers. It includes branching to maintain code when programs evolve on multiple paths. Personal PVCS offers most of the power and flexibility of corporate PVCS, but excludes multiple programmer features. Network PVCS is the Corporate version for LANs. File locking and security levels can be tallowed to such was allowed to such was allowed. can be tailored to each project

| Ask for:   | List  | PC Brand |
|--|-------|----------|
| Personal PVCS  | \$149 | \$129    |
| Corporate PVCS   | \$395 | \$329    |
| Network PVCS   | Call  | Call     |
| PolyMake   | \$149 | \$129    |
| The same of the sa |       |          |

#### dBC Identical dBASE III Plus Files Using C

BCTM is a series of C libraries from Lattice which creates, accesses and updates files identical to those of dBASE itself. So dBASE can read and update the

What for? It means both C and dBASE applications can operate on the same data bases interchangably. It means C

Payment: We honor MasterCard, Visa, American Express (no surcharge), checks in advance, or funds wired to PC Express, c/o Chemical Bank, 126 East 86 St., New York, Account 034-016058. COD (U.S. only) for cash, money order, certified check (no fee). NY State, add sales tax. Purchase orders accepted from larger corporations and institutions at our discretion if you agree to net 30 days plus 2% a month late penalty thereafter.

Shipping & Handling: U.S.: UPS Surface: 1st product \$56, each add! \$3. UPS Next Day Air: sts product \$56, each add! \$5. UPS Next Day Air and Federal Express shipment costs based on weight. International: Charges vary by destination and carrier. \$10 per shipping container for export forms. Air parcel post at your risk beyond collected insurable amount.

programmers can interface with the big market of dBASE users out there, yet side-step the dBASE language. It means dBASE applications can now be linked to the universe of C libraries and tools to add windows, graphics, statistical analysis, all the things dBASE cannot do. It means the speed and power of C to impress clients accustomed to dBASE!

dBC's functions parallel all dBASE's file handling commands, many decomposed to permit direct data manipulation. Our versions of dBC mimic file formats for dBASE II and III and now dBASE III Plus makes your programs network ready!. as many stations as a network allows. Hands-off mode handles record and file locking and unlocking automatically.

Close in functions give you direct lock/

unlock control.
Supports all four memory models.
dBASE II, III...List: \$250, Ours: \$175.
dBASE III Plus...List: \$750, Ours: \$595. Call for Source Code Pricing.

#### C-WORTHY INTERFACE LIBRARY

he C-Worthy TM Interface Library wraps an entire user interface around your application. Its full power can be summoned by only a few high level calls. Sound exaggerated? A single function call can set up a complete text editor in a screen window. Recently acquired by Solution System, over 600 pages of Documentation, Turbo and Quick C version and a complete Interface Library have been added.
• High level calls pop menus and scroll-

able choice lists to the screen, restoring the background when dismissed.

Windowing facilities open portholes of

up to screen size for viewing virtual screens larger than the physical screen. • Full context-sensitive help screen man-

agement takes over these chores and error messages. Automatic routines interrupt with pageable text windows explain-

ing what to do next.

Novell found it "played a key role and accelerated development" in making its NetWare<sup>TM</sup> utilities easier for users. Ingenious demo: call for it

Ask for: List: PC Express: C-Worthy \$195 with Forms Library

#### THE SPINDRIFT LIBRARY

#### Fully Functional Fortran Library.

Spindrift's smooth package offers something previously unavailable to the Fortran buffs...a basket of functions, packed to the brim. No more tedious coding. Just call on Spindrift with it's armoury of functions.

Any number of Windows may be defined, each with a striking border and brilliant color. Define "pop-up" screens, Save/Restore images, set Cursor shape. Snare an entire screen into a

The Keyboard; read it without echo, or sense any keypress during execution. Cursor controlled directly with Edit kevs

DOS interface includes: Call System, Call Exec, Findfrst/Findnext for (\*) and (?) file searching. Search the Path, subdirectory and file manipulation, command line argument parsing, date/time functions, DOS environment access, and much more. Other utilities also included. Specify compiler, Microsoft or Ryan McFarland. List: **\$149.00**. Us: **\$129.00** 

#### PC EXPRESS™

A Division of PC BRAND

150 FIFTH AVE., NEW YORK, NY 10011-4311 PHONE: 212-242-3600 FAX: 212-627-1171 TELEX: 667962 (SOFT COMM NYK) All prices subject to change. Delivery subject to availability.

ing via UPS \$6.00. \$3.00 for each additional product. Call for overnight delivery charges.



OVERNIGHT SOFTWARE DELIVERY

#### PC EXPRESS" PROGRAMMER'S WORKBENCH

#### dbase at the speed of c

dBx Translates dBASE Applications to C

You dBASETM programmers know what an expressive and readable language dBASE is. It's a very comfortable development environment. But the price is debased performance. Even compiled abased performance. Even compiled dBASE doesn't offer the speed that some users require these days. The kind of speed offered by software written in the C language. The answer is dBxTM dBx translates dBASE to C. It offers you make compilities advantage over the

a major competitive advantage over the next dBASE programmer: Keep writing in dBASE. Take every application all the way to completion. Then use dBx to translate them top to bottom to C

Other advantages: C is portable, even to other operating systems like UNIX/ Xenix<sup>TM</sup>. To the Macintosh or Amiga. dBx gives your applications a passport to

dBx gives your applications a passport places dBASE cannot go.

Has its own file manager for single user, but links to major C file managers—c-tree and dBC—for compatibility with dBASE files or multi-user support. We have everything you'll need, including good advice

|                             | List: | Ours: |
|-----------------------------|-------|-------|
| Bx                          | \$550 | \$419 |
| ith Library Source          | \$950 | \$725 |
| all for Full Source Priging |       |       |

#### BRIEF/dBRIEF

#### The Power Environment for dBASE Programming

Many worthy utility products supply needs that dBASE® s programming lar guage doesn't—dUTILITM, dFLOWTM and a host of others. Trouble is, you have to use them separately, then combine their output into your dBASE program

No longer, dBRIEFTM, written in BRIEF's macro language, grabs hold of BRIEF's macro language, grabs noted of BRIEF and turns it into a complete dBASE III and III Plus programming domain. Using BRIEF's underlying shell capabilities and its own interfaces, dBRIEF can run external utility libraries, plus dBASE itself, and link to the Clipper TM, Foxbase + TM and Quicksilver compilers, all with ABIEFS still leaded and purping all with dBRIEF still loaded and running the show. It can do what BRIEF already does plus:

· Convert a screen layout into dBASE code for interactive data entry.

 Display dBASE file structures in windows, a great convenience alongside your program files

• Expand keystrokes into full dBASE

 Indent automatically for clegic display.

Create databases; index files; invoke Ashton-Tate's dFORMATTM and dCONVERTTM; draw lines and boxes.

"Simply marvelous programming environment for writing and editing dBASE programs.", *PC Magazine*, 7/86. Source code included!

code included!
Requires BRIEF 1.32 or later and 384k;
512k to run dBASE within dBRIEF; 640k
and harddisk recommended.
BRIEF/dBRIEF...List \$275,Ours: \$219.

#### **NOVELL: BTRIEVE, XQL, XTRIEVE**

#### Sophisticated Tools Essential For Fast Database Handling

Btrieve is a library of subroutines that allows the programmer to build a data-base application using any language. It takes complete charge of all file creation, indexing, reading, writing, insertion, deletion, forward and backward searching. Its balanced tree indexing scheme finds any key in a million in less than 4 accesses...That's fast!

Btrieve is multi-lingual also. It includes more than 20 language interfaces (including C, BASIC, PASCAL, FORTRAN). However if it turns out that you are using something a little unusual, worry not. The manual includes a chapter on how to write a language interface to Btrieve.

Btrieve's vital statistics are equally impressive. Files may have up to 24 indexes; fixed record length to 4090 characters; variable length to 64K; indexes to 255 characters; files of 4 billion bytes. Network support includes Novell, 3-COM, IBM PC NET, Software Link's Multilink and many others.

XQL is a relational database manage-ment system designed especially for programmers. Imagine being able to your database with the ease of SQL (Structured Query Language) statements and still having the power to process that data right down to the byte level.

Think about your applications. A large part of your software development effort is probably devoted to managing data stored in files on disk. Hours spent writ-ing lines of code to search and store data

records could have been used to prorecords could have been used to program more important parts of your application. Why not let XQL do it for you. XQL will increase your programming productivity and let you focus on building better programming and let you focus on building better applications.

The XOL system works in tandem with Btrieve and has an equally powerful chassis...No limit on the number of records per file. Max. file size is 4 giga-bytes, Max. record size equals 4K, Max indexes per file is 24. The one version works for single or multiuser systems, DOS Ver 3.0 or greater. All languages are supported.

Xtrieve is the final ingredient in the Novell programming recipe. It is a menu driven, data retrieval system, that allows you to quickly find information and dis-play reports. System developers can easily customize Xtrieve to display command menus, help files, and error messages in the English spoken by the customer. Xtrieve screens then gives menu choices that users can quickly recognize, making Xtrieve an easy product to use and understand.

Report Option for printing customized reports, form letters, mailing labels &

| Didicinonio.    | The second |       |
|-----------------|------------|-------|
|                 | List:      | Ours: |
| Btrieve         | \$245      | \$175 |
| Btrieve/N       | \$595      | \$445 |
| XOL             | \$795      | \$595 |
| Xtrieve         | \$245      | \$220 |
| Xtrieve/N       | \$595      | \$459 |
| Report Option   | \$145      | \$128 |
| Report Option/N | \$345      | \$269 |
|                 |            |       |

#### APPLICATIONS PLUS For dBASE

The Complete dBASE Companion

Who says you can't have it all? APPLICATIONS PLUS has everything you need to get the most out of dBASE: An application generator (QUICKCODE PLUS), relational report writer (QUICK-REPORT), and graphics system (dGRAPH).

QUICKCODE PLUS offers dozens of

features you've *never* seen before in a dBASE code generator. Relational applications that read, display, and update a dozen or more databases simultaneously "Real-time" calculations, performed on

screen as the user enters each field.
Forms up to 11 screens long, with the ability to pass data between screens Computational formulas that automatically combine data from different databases. 9 Data types. 16 field types

QUICKREPORT is a full-featured relational report writer, which combines up to 6 databases in one report, handles many to-one relations, fancy printer features (like **bold** and *italics*), computed fields

(like **bold** and *italics*), computed fields, and up to folevels of totalling and sorting. dCRAPH is a graphics system that produces bar, pie, line, and piebar charts directly from dBASE data. Dozens of options let you tailor graphs to your needs. APPLICATIONS PLUS is 100% compatible with Clipper and FoxBASE+.

| APPLICATIONS   | Dist. | Ours. |
|----------------|-------|-------|
| PLUS           | \$299 | \$249 |
| QUICKCODE PLUS | \$295 | \$170 |
| QUICKREPORT    | \$295 | \$170 |
| QUICKENTRY     | \$ 99 | \$ 59 |

#### GSS GRAPHICS SYSTEM Leave the Device Driving to GSS

For serious applications stick to the tools that stick to the standards. Not the least of reasons why GSSTM has emerged as the pre-eminent graphics toolmaker is that it

has always conformed to ANSI standards.
At the heart of the system is the CGI standard Development Toolkit. It has all language interfaces and device drivers for keyboards, mice, joysticks, tablets, printers, plotters, cameras. The drivers completely insulate your application from concern for device idiosyncracy

GSS Kernel<sup>TM</sup> conforms to ANSI's GKS

2b and has all its drivers and language bindings. Macro level tools to draw, color, segment, transform, store and recreate an object. The Metafile Interpreter reads ANSI CGM files with full CGI capability for recreation on various devices.

Quality software? IBM thinks so. They

sell GSS under their own label. Royalties.

| Needs 256k.          | List: | Ours: |
|----------------------|-------|-------|
| CGI Dylpment Toolkit | \$495 | \$425 |
| Cernel System        | \$495 | \$425 |
| Cernel for IBM RT    | \$795 | \$645 |
| Metafile Interpreter | \$295 | \$265 |
|                      |       |       |

#### **CLIPPER**

\$399

R&R RELATIONAL REPORT WRITER

#### MORE PROGRAMMING MICROSOFT LANGUAGES TOOLS FOR...

dBASE, C, FORTRAN, BASIC, COBOL, PASCAL

dbc ISAM, FoxBASE, Greenleaf, Halo '88, Logitech MODULA, MicroFocus COBOL, Norton Utilities, Panel Plus, Periscope, Phoenix, Polytron, RM/COBOL, Sprindrift, Tom Rettig's Library, Windows for Data...and many more.

Call or write for prices and information.

CIRCLE NO. 233 ON READER SERVICE CARD

#### Powerful Implementations Of The Most Popular Programming Languages

Microsoft C 5.0: The flagship of the Microsoft line runs up to 30 percent faster than its predecessor. Its new optimization features deliver untouchable execution speeds, 100 new additional library routines.

Microsoft MacroASSEMBLER 5.0: If you ever wanted to take on the challenge of assembly, here's your opportunity. "MASM" 5.0 is a lot easier to use, has completely revised documentation, and a new "Mixed Language" programming guide that gives you step by step instruc-tions for linking your assembly code with other Microsoft languages. Microsoft QuickBASIC 4.0: is a revolu-

tionary concept in BASIC programming. It allows you to run, edit, debug, and run again. Our friends at Microsoft have eliminated the dreaded compile step. Whenever you edit your code QB4 automatically incorporates your changes, so that it can run a program of 150,000 lines in less than a minute.

Each member of this language family includes the renowned debugger CODEVIEW.

|                      | List: | Ours  |
|----------------------|-------|-------|
| Microsoft C          | \$450 | \$295 |
| Microsoft Macro-     |       |       |
| ASSEMBLER            | \$150 | \$109 |
| Microsoft QuickBASIC | \$ 99 | \$ 66 |
| Microsoft FORTRAN    | \$450 | \$295 |

PC EXPRI





OVERNIGHT SOFTWARE DELIVERY

150 FIFTH AVE., NEW YORK, NY 10011-4311 PHONE: 212-242-3600 FAX: 212-627-1171 TELEX: 667962 (SOFT COMM NYK) All prices subject to change. Delivery subject to availability. Shipping via UPS \$6.00. \$3.00 for each additional product. Call for overnight delivery



restriction based on the size of the screen) and can be alphanumeric, numeric-only, alphabetic-only, date, integer, long, float, or double-precision. Pro-C does not support memo fields that are found in other databases, but automatically updates cross-reference links to other files.

Once the files have been generated, Pro-C defines the menus, reports, screens, and update programs. The screen generator creates add/update/inquire/delete programs for files. Various prompt formats are allowed, multiple validations for each field can be specified, and computations included.

A screen painter within Pro-C allows the developer to customize the screens. The report generator allows multiple breaks, runtime entry of selection conditions, computed fields, and the choice of printing data either to disk or to a file. The menu generator permits the developer to call reports, menus, and screen programs from one-or two-column menus. Unfortunately, the menus do not have any security protection for locking programs from unauthorized users.

By using Pro-C's powerful update program generator, the developer can, for example, generate an update program to perform monthly aging on accounts-receivable customers or to compute quarterly payroll taxes. The types of processing possible include in situ file update; file extraction; and old master in, new master out. As part of an update, fields can be moved from one file to another and new field values can be computed.

With Pro-C, the developer can make an application easier to use by building context-sensitive help into the programs. Text must be entered for every field of every screen (which is a somewhat tedious process), but the rest of the process is automated. If the help file for a program is missing, however, Pro-C recovers gracefully in the generated program and notifies the user of the problem.

After a program is defined completely, Pro-C produces a C source file. The generated C code is excellent, including many comments and the type of functional organization that a good programmer would choose. An experienced C programmer will have no trouble modifying these programs. The programs that are generated work well and should produce no surprises to an average PC user. Pro-C's user interface for data input and editing, however, is in need of some polishing. For exam-

ple, individual fields in a record are edited by first selecting their field number, a method that is a little behind the times.

Along with generating the source code, Pro-C generates reports for every file definition, screen program, report, and menu. While hardly fit for the end user, these reports easily can be read into a word processor and then annotated to produce a competent user's manual.

The manual for Pro-C itself—144 typeset pages without an index—is choppy and often describes the product in glowing terms best reserved for marketing literature. In general, however, it serves as a good overview of the program's facilities. Complete, context-sensitive help is available by pressing the F1 key from inside the program, so that, once installed, the developer can run the program successfully without referring back to the Pro-C documentation.

Most of Pro-C's drawbacks are imperfections found in any program generator—they are the price one pays for using prefabricated components. For example, the user interface that Pro-C writes into programs is not very sophisticated, although it is serviceable and consistent. The developer will have to make considerable use of the screen painter in order to use colors or modify the generated code to gain access to a text library such as the one now present in Turbo C.

In addition, not every application will fit into Pro-C's model of menus, reports, and screen updates. It is important to recognize the limits of the system. The developer who ends up extensively modifying generated source code may be asking too much of any program generator. Corporate programmers who wrestle with host database access, graphics windowing environments, and security-conscious management will find Pro-C too simple, although it would make an effective prototyping tool.

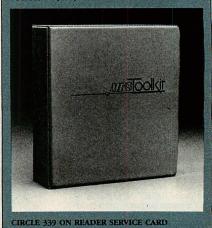
Pro-C excels at what it was designed for—generating source code for small- to medium-sized, traditional data processing systems. The time invested in learning to use the package will be repaid in faster coding and system delivery, which will produce an increase in profits for the developer. Faults and all, Pro-C is a worthwhile tool that eliminates some (but not all) of the drudgery inherent in writing custom business software.

-MARTY FRANZ

#### MKS TOOLKIT 2.3

Mortice Kern Systems Inc. 35 King Street North Waterloo, Ontario Canada N2J 2W9 800/265-2797; 519/884-225.

PRICE: \$169



evelopers who use UNIX and DOS often are frustrated by the differences between the two operating environments. The MKS Toolkit 2.3 from Mortice Kern Systems helps ease the transition between the two systems by emulating the UNIX environment on a PC. This allows the developer to use UNIX work habits under the DOS environment.

The MKS Toolkit consists of about 130 programs, mostly small, that closely emulate the most-used UNIX commands. UNIX System V has twice the number of commands, but some of them are used rarely and others are not useful in a single-user, single-tasking environment.

Important omissions are the SCCS package for version control (MKS sells its own version-control system separately) and the uucp communications package. The parser generator, yacc, is included in the toolkit, but lex (the lexical-analyzer generator often used in conjunction with yacc) is not. The command processor supplied is the Korn shell. The full toolkit, excluding the spelling checker and dictionary, consumes more than 1MB on a hard disk.

All the MKS tools emulate their UNIX equivalents very closely, with the same options in most cases. Differences usually reflect irreconcilable incompatibilities between the two systems. The chmod command (which changes fileaccess permissions), for example, has options corresponding only to what is possible under DOS.

The toolkit employs four configurations that differ in the way the shell (command processor) is used. The first and simplest configuration does not use the shell at all; the DOS command processor, COMMAND.COM, remains in control. This is a comfortable setup for users unfamiliar with UNIX who want to have access to the toolkit. The second configuration uses the toolkit shell, but runs it from COMMAND.COM. While acceptable for occasional use, this configuration wastes memory because COMMAND.COM stays in RAM even though it is not used. The third configuration (which is the one most similar to UNIX) specifies the toolkit shell in the CONFIG.SYS file as the command processor; consequently, COMMAND.COM need not be loaded. The last configuration provides a UNIX-like login, with home directory and other characteristics of the environment, depending on login name. This configuration is very useful on a multiuser machine.

The Korn shell (which becomes the command-line interface in all but the first configuration) is highly compatible with the Korn shell available on many UNIX systems. In addition, it is compatible with the Bourne shell supplied with System V, with the exception of constructs that are inapplicable to single-tasking DOS. UNIX shells, for example, allow any command to be followed by an ampersand, which has the effect of running the command as "background processes," so that the user can do other work while the command is executing.

For this review, several UNIX shell scripts were tested, including an accounting package written by Rich Bilancia and published in UNIX World (July 1987). Only minor changes needed to be made. Problem areas are in file names (DOS has more restrictions on file names than UNIX does, so some file names must be changed) and in command options that do not apply to DOS. The MKS Korn shell is slightly faster than COMMAND.COM for comparable operations—somewhat of a surprise because it also is more powerful. The MKS Korn shell, however, is larger—more than 80KB compared with 3KB for COMMAND.COM. Its size could be a problem when used with large spreadsheets or other programs that require a lot of memory.

The toolkit includes a version of the vi editor that practically is identical to the UNIX vi editor. All options of the UNIX vi editor are supported, except for LISP mode, file recovery, and reduced-size windows. The MKS vi documentation is more understandable than the original UNIX manual, especially for new users of vi. For many UNIX users, vi will be an essential part of the toolkit. The vi editor is relatively old, however, and is not as powerful as other UNIX editors (such as EMACS and its descendants). Ideally, a toolkit should include a more modern editor, such as Solution System's BRIEF or Lugaru Software's Epsilon, which provide features such as windows.

The UNIX programming language, awk, is included in the toolkit and is most useful when manipulating files

that contain tabulated data and can be treated as databases. (Bilancia's accounting package relies heavily on awk.) To make full use of this language, the developer will need to supplement the documentation supplied with the toolkit with books or tutorials on awk. The MKS documentation is more complete than the standard UNIX-manual entry for awk, however, and is sufficient for simple uses.

The powerful UNIX stream editor. sed, is included in the toolkit and is most useful for making complex systematic changes to a large file or for converting the output of one program into a form acceptable to another. Sed takes its commands from a script file and acts as a filter, applying the commands to an input file and writing the results to standard output (often redirected to another file). A typical standalone application is the conversion of a source program from one programming language to another. The version of sed in the toolkit has one minor difference from System V sed: the b command, which branches to another point in the script file, must always branch to a label. In System V sed, the label may be omitted, in which case sed branches to the end of the script.

Because the MKS Toolkit shell is similar to a UNIX environment and different from the usual DOS environment, questions of compatibility must be addressed. Most ordinary DOS programs run from the toolkit shell without problem. The MKS start-up procedure changes the DOS option switch from a slash to a dash, so that DOS

"The most rock-solid C compiler in the industry. Superb technical support and portability.

Gordon Eubanks, Symantec-Q&A (386). "It simply works, with no trouble, no chasing strange bugs, and excellent warning and error messages ... a professional product." Robert Lerche, Bay Partners. "For large-scale software development, the highest quality C compiler available on the market today. Pragmas are great. Quality of support is exceptional."

Randy Neilsen, Ansa - Paradox (DOS, OS/2).

"15% smaller and 15% faster than Lattice C." Robert Wenig, Autodesk - AUTOCAD. "Our software is running anywhere from 30 to 50% faster than when compiled under Lattice." D. Marcus, Micronetics. "Best quality emitted code by any compiler I've encountered. Often amazing."

Bill Ferguson, Fox Software-FoxBase (386). "We found that messages sometimes pointed out type mismatches, incorrect-length argument lists, and uninitialized variables that had been undetected for years [in UNIX 4.2 bsd]."

Larry Breed, IBM ACIS.

#### Check Out These Reviews

· High C TM:

Computer Language Dr. Dobb's Journal PC Magazine Dr. Dobb's Journal BYTE Magazine

Professional Pascal TM: PC Magazine Computer Language PC Tech Journal J. Pascal, Ada & M-2

BYTE Magazine

Dec. 29, 1985 May 1986 July 1986 Nov.-Dec. 1986 Dec'86, Jun'87(80386)

February 1986, '87

(80386)

(80386)

(80386)

August 1986

Jan. 27, 1987 July 1987

Nov. 1987

#### A Partial List of Optimizations

Common subexpression and dead-code elimination, constant folding, retention and reuse of register contents, jump-instruction size minimization, tail merging (cross jumping), short-circuit evaluation of Boolean expressions, fast procedure calls, strength reductions, and automatic mapping of variables to registers, ...

CIRCLE NO. 259 ON READER SERVICE CARD

Sun, Apollo, SGI, 8086-286, RT PC, VAX, 370, 29000

#### Power Tools for Power Users

Ashton-Tate: dBase III Plus, MultiMate: Autodesk: AUTOCAD. AUTOSKETCH (8087, '387, Weitek); Boeing Computer Services (Sun); CASE Technology (Sun); CAD/CAM giant Daisy Systems Corporation ('86, '386, VAX); Deloitte Haskins & Sells; Digital Research: FlexOS; GE; IBM: 4.3/RT, 4680 OS; Lifetree Software (Pascal): Volkswriter Deluxe, GEM-Write; Lugaru: Epsilon; NYU: Ada-Ed; Semantec: Q&A; Sky Computers; ... (Product names are trademarks of the companies indicated.)

(408)429-6382

Since 1979.



INCORPORATED

903 Pacific Avenue, Santa Cruz, CA 95060

The Clear Choice for Large Programming Projects - PC Tech J.

### ASYFLOW

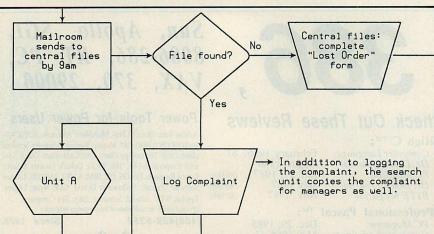
n on-screen flowchart processor that knows about flowcharts - not just another "screen draw" program that makes you do most of the work. EASYFLOW is a powerful full-screen graphics program dedicated to flowcharts and organization charts. With it you can quickly compose charts. More important, you can easily modify charts so they are always up to date.

- ► Automatic: Fully automatic text centering within shapes, both horizontally and vertically. Fully automatic line routing & re-routing.
- Fast: Written in assembly language for speed.
- ► Large: Charts up to 417 columns wide by 225 lines high. Chart too large for your printer? EASYFLOW automatically breaks the chart up & prints it in page size pieces.
- ► Standard: All standard flowcharting shapes included. Custom shapes can be ordered.
- ► User friendly: Don't take our word for it. PC Magazine\* says "EASYFLOW lives up to its name. It's hard to imagine any easier and more flexible way to produce basic and even complex flowcharts".
- ➤ Mouse: Optional but fully supported.
- ▶ It prints: On most popular matrix printers including IBM, Epson, Toshiba, HP LaserJet, LaserJet-Plus and many others.
- ▶ It plots: On HP7440, 7475, 7550, 7570, 7585B and compatible plotters.
- ► It works: We are contractually prevented from mentioning the name of the "big eight" accounting firm that purchased a world-wide site license, but we can tell you that they spent months evaluating all available flowcharting packages before choosing EasyFlow.
- ► Rush delivery: Order by noon today (eastern time) and we'll have it to you by courier tomorrow\*\*. Rush delivery charge is \$15.00 (instead of \$2.00) and is available only in USA & Canada.
- ▶ **Documented:** 100 page manual plus over 150 screens of context sensitive help. EASYFLOW works on IBM PC's, IBM PS/2 and compatibles. Requires 384 K memory, DOS 2.0 or higher and an IBM CGA/EGA/VGA or Hercules monochrome compatible adapter card.

Order direct for only \$149.95 + \$2.00 S&H (USA/Canada), \$10.00 (foreign). Payment by M.O., cheque, VISA, Mastercard or Company PO.

March 10, 1987 issue, page 278.

Rush orders are shipped by Purolator Courier and normally arrive the next business day to most locations. Remote destinations take longer.



The chart fragment above was produced on an HP LaserJet-Plus and is actual size and unretouched. Publication quality charts like this can be produced using only minutes of preparation time and seconds of print time.

**HavenTree Software Limited** PO Box 1093-N Thousand Island Park, NY 13692

Order Desk: 1-800-267-0668 Information: (613) 544-6035 ext 48

Telefax(G3): (613) 544-9632

#### PRODUCT WATCH

programs can be invoked in the same manner as MKS tools and will accept a slash as the delimiter in file path names. Although DOS is designed to allow this, the DOS function calls that support changes to the option switch are undocumented by Microsoft. Many applications, therefore, do not recognize the change. For example, Turbo C runs without problem in its integrated environment; developers can even use its command-line compiler, tcc, because it expects UNIX-style options anyway. Its linker, on the other hand, expects options in DOS style: /m instead of -m, with a backslash used as the separator in path names.

Another situation in which DOS conventions force their attention onto a user arises when an application allows temporary escape to DOS. A toolkit user might expect that the application would give control to the toolkit shell, but usually would be disappointed. Most applications with this feature give control to the program named in the environment variable COMSPEC, which must be the path to COMMAND.COM. Ideally, the program that has its path in the environment variable SHELL should be given control; however, few applications, if any, do this.

The 400-page MKS Toolkit manual describes the use of many of the tools much better than the original AT&T UNIX documentation does. A general overview section will be useful to users who have little or no UNIX experience. Developers, however, who wish to use the more complex tools (such as sed, awk, and vacc) will need to supplement the MKS documentation.

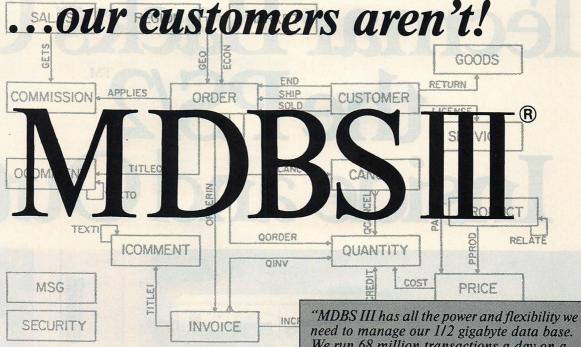
Is the MKS Toolkit a worthwhile purchase? At \$169, its list price is now comparable to that of the environment it emulates—\$199 for a bare-bones 80286 or 80386 version of UNIX from Microport. A true UNIX system, however, requires at least 2MB of RAM and a processor with hardware support for paging (such as the 80386) to perform well. To run DOS applications, a DOSunder-UNIX product such as Locus Computing's Merge also is required.

The MKS Toolkit brings the best part of UNIX—its utilities—to DOS. (MKS plans to release an OS/2 version of the toolkit before the end of 1988.) It provides relief for the frustrated UNIX developer trapped in the DOS environment. For the DOS developer puzzled over the excitement about UNIX, the MKS Toolkit reveals what the shouting is all about.

—NICK JACOBS



### Looking for a data base?



This extended network DBMS is designed and implemented to maximize productivity, and to handle large volumes of data, complex data structures and high performance requirements.

We run 68 million transactions a day on a LAN with 40-60 users and get 1½-2 second response time.'

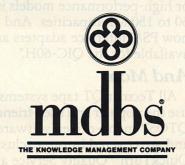
Charles Gallagher, consultant for Fermi National Accelerator Laboratory

- Real-world data relationships. MDBS III® supports many-to-many, many-to-one, one-to-many, one-to-one, forked and recursive relationships.
- Very large data bases. MDBS III data bases of 500MB exhibit split second response times.
- Performance tuning. Change page sizes; cluster records; add, delete or change areas, records or data items; consolidate disk space; hashed access; controllable index widths.
- Query. A non programmer can interrogate any MDBS III file on an ad hoc basis.
- Fault tolerance. MDBS III closes the window of data vulnerability with transaction logging, pre-image posting and transaction abort facilities.
- Interactive data manipulation. Perform any data base command interactively from the console without programming.
- Administration. MDBS III provides the ability to measure the integrity of a data base and repair it if necessary.
- Restructuring and reorganizing. Minimize fragmentation by reorganizing and compacting the data base.
- Environments and servers. MDBS III is available for the IBM® PC and compatibles; PS/2; IBM, Novell and 3COM LANs; VAX® and other fine minis; DECnet and VAX® Clusters. MS-DOS®. OS/2®, VMS®, UNIX® and XENIX®.

- Support. We offer hands-on product training and are committed to provide the best technical support there is.
- Professional Services. We can assist with tasks from project specification to developing turn-key solutions. Our Equity Program allows a credit towards future application development costs.
- Other fine mdbs products. We also offer GURU, and expert system environment and KnowledgeMan/2, a relational DBMS development system.

mdbs products are offered worldwide. For MDBS III-Australia: International Nexus Corporation,
(3) 589-7411; Belgium: Informatica, (02) 659-8610; (6) 357-711, Belgium. Informatica, (62) 639-8610; Finland: Businessman OY, (0) 59131; France: ISE CEGOS, (1) 46 09 28 28; Netherlands: Information Efficiency Consultants, (02) 154-15708; Singapore: Soft-Pro Computer Pte Ltd, 2545245; Sweden: Datorisering AB, (8) 753-3090; Switzerland: Also Comsyt, 953733; United Kingdom: MDBS International, Ltd., (1) 493-3677; West Germany: Also Comsyt (89), 699-2960.

GSA contract number: GS00K88AGS86181



#### CHECK US OUT

- **Expert Systems integration**
- Real world structuring
- Multi-user & LAN server
- Unlimited number of records
- Multiple language interfaces Data independence
- Data protection & integrity
- Data security/privacy
- 32K+ fields/record
- SQL Preprocessor

800-344-5832 • 317-463-2581 FAX 317-448-6428

Telex 9102401559 (MDBS WLAF UQ)

For more information attach your business card and mail to:

> mdbs, Inc. Marketing & Sales P.O. Box 248 Lafayette, IN 47902

Please send information on:

- ☐ MDBS III Specifications
- Information/Training Seminars Professional Services
- Service and Maintenance
- ☐ Environments

  - ☐ VMS ☐ MSDOS ☐ OS/2 ☐ UNIX
- I'm enclosing \$120 in payment for the MDBS III manual (In Indiana add \$5.50 sales tax).
- Please charge my ☐ MasterCard □ VISA or □ American Exp.

| Signature | The same of the sa |
|-----------|--|
| Card No.  | LABIN LOTO ONLO  |
| Phone No. |  |

MDBS III, GURU and KnowledgeMan/2 are registered trademarks of mdbs, Inc. Other trademarks shown are proprietary to their respective manufacturers CIRCLE NO. 141 ON READER SERVICE CARD

# Tecmar Backs Up the PS/2<sup>m</sup> Inside and Out.



An advanced personal computer like the PS/2 demands advanced data protection. That means Tecmar tape backup.

Long the leader in backup for XT®s and AT®s, Tecmar also offers a wide selection of both internal and external tape systems for the PS/2. And, with over 30,000 PS/2-compatible units in the field, we're already the leader in PS/2 backup.

#### Inside...

Tecmar's internal tape backup systems are easy to install and use. Select from our low-cost, floppy-interface 40MB models or, for high performance, choose from our 60 to 150 MB models. **Outside...** 

Tecmar's external QT tape systems offer maximum ver-

satility. With extra interface adapters, a single external drive can back up multiple computers. And, because we offer interface adapters for ATs and XTs in addition to PS/2s, you can even use one drive to back up *both* Micro Channel™ and classic bus systems! So now you can share the cost and protection.

Select from our economical 40MB floppy-interface model or high-performance models in 60 to 150 MB capacities. And now PS/2 interface adapters are available for the QIC-60H.\*

#### And More.

All Tecmar QT tape systems use the popular and user-friendly QTOS™ menu-driven software and are covered by our exclusive QuickTurn™ Quality Service and CIRCLE NO. 225 ON READER SERVICE CARD

two-year warranty. So choose your tape system solution from the leader in PS/2 backup—Tecmar, quality inside and out. Call us now at (800) 624-8560 or (216) 349-1009. Tecmar, Inc., 6225 Cochran Road, Solon, Ohio 44139-3377

\*QIC-60 tape drives use QIC software, are covered by a one-year warranty and are not covered by QuickTurn Quality Service.



PS/2 and Micro Channel trademarks. XT, and AT registered trademarks of International Business Machines Corp.: QTOS and QuickTurn trademarks of Tecmar. Inc.: QIC-60 registered trademark of Colorado Memory Systems. © Copyright Tecmar. Inc.. a subsidiary of Rexon. Inc.. 1988. All rights reserved.

#### TECH NOTEBOOK

A forum for sharing solutions to technical problems

DOS BOOT

2 OS/2 BOOT

3 DUAL BOOT

espite the many innovations that have been introduced by OS/2, it shares many features with DOS. One of the major ones is the common file system that allows easy data migration between the old and new operating systems. As a result, DOS may reside on the same disk partition as OS/2, something that is not possible with, say, UNIX. Using this capability, Microsoft has added a dualboot feature to OS/2. This allows the user, with a single keystroke, to boot either DOS or OS/2 from the same hard disk, without the bother of handling diskettes or, worse, running FDISK to reset the active partition.

The dual-boot feature is an option that each OS/2 vendor can choose to include or omit. It was omitted from both the IBM and Compaq releases of OS/2 1.0, but it is included in versions from Microsoft (in the OS/2 Software Development Kit), AST Research, and Dell Computers. Dell's version has the very useful additional feature of being able to time-out and boot OS/2 by default if the user does not respond in about 15 seconds.

The third item this month describes a method of adding a dual-boot capability to any version of OS/2, following Dell's example of booting a default system after a time-out interval. You can choose both the interval and the default when you implement this feature. You may also want to customize a system that already has the dualboot feature but waits forever for user input or chooses the wrong default. It is very convenient to flip the power switch in the morning, go get coffee, and return to a computer already booted into the system you use most frequently.

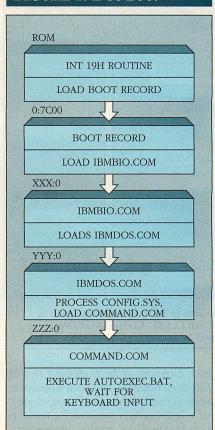
To lay the groundwork for installing this feature, the first two items describe the similarities and differences in the individual boot processes of DOS and OS/2.

#### 1

#### THE DOS BOOT SEQUENCE

The DOS boot sequence shown in figure 1 is described in detail in IBM's DOS Technical Reference. The four files IBMBIO.COM, IBMDOS.COM, CONFIG.SYS, and AUTOEXEC.BAT must be in the root directory of the boot disk; their names are hard-coded into the programs that load them. The only component whose name and location can be specified by the user, by

#### FIGURE 1: DOS Boot



Each component reads in the next piece, so the operating system brings itself up "by its own bootstraps." means of the SHELL statement in the CONFIG.SYS file, is COMMAND.COM.

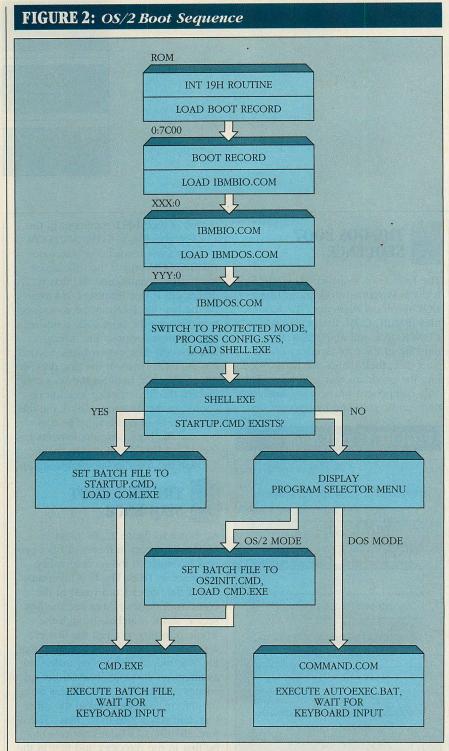
The boot record code can load IBMBIO.COM only if the disk layout meets three conditions. The first requirement is that IBMBIO.COM must be the first file listed in the root directory, because the boot code reads in only the first sector of the directory and tests the first eleven bytes. Second, the file must begin in the first data sector on the disk, because the boot code ignores the file's starting location recorded in the directory. Third, the file must consist of consecutive sectors, because the boot code implements no logic for following allocation chains through the file allocation table (FAT).

#### 2

#### THE OS/2 BOOT SEQUENCE

As shown in figure 2, the initial sequence of events in the OS/2 boot process is similar to the corresponding sequence in DOS. The first difference is that the boot record reads in the entire root directory, not just the first sector, and it searches through the whole directory, not just the first eleven bytes, to find IBMBIO.COM. If that file is found, the boot code makes no assumptions about its location but calculates the absolute disk address from the information specified in the directory, and reads it in from there. Therefore, IBMBIO.COM does not need to be first in the directory and first in the data area on an OS/2 boot disk. However, this file still needs to be contiguous, because the boot code reads the required number of sectors in sequence, starting from the calculated starting location.

IBMBIO has a function analogous to its namesake in DOS. IBMDOS switches into protected mode, processes CONFIG.SYS, and starts up the protected-mode interface shell named in the PROTSHELL statement of the



The beginning of the sequence is similar to that in DOS, but the latter part is more complex. The locations and names of SHELL.EXE, COMMAND.COM, CMD.EXE, and OS2INIT.CMD can be changed by entries in CONFIG.SYS.

CONFIG.SYS file. In version 1.1 of OS/2, the first-level interface can be either PMSHELL.EXE, the graphics interface of Presentation Manager, or SHELL.EXE, the text-based interface of the Session Manager.

The shell program looks for a batch file named STARTUP.CMD in the

root directory of the boot drive. If that file does not exist, the shell displays a session-manager menu (in text mode) or a task-manager window (in Presentation Manager) for starting application programs or one of two command-line processors (see "Enter OS/2," Ted Mirecki, November 1987, p. 52). If the

user chooses the protected-mode processor, the shell starts up CMD.EXE; this program first executes the OS2INIT.CMD batch file, then issues a command-line prompt and waits for user input. The names and locations of CMD.EXE and OS2INIT.CMD are not hard-coded into the shell, however, they can be changed by parameters on the PROTSHELL statement of the CONFIG.SYS file.

Choosing the real-mode command processor starts up the program that is named in the SHELL statement of the CONFIG.SYS file (not to be confused with the SHELL.EXE program, which is the protected-mode text-based interface that starts command processors and other programs). The standard real-mode command processor provided with OS/2 is named COMMAND.COM. Like its DOS counterpart, upon startup this command processor executes the batch file AUTOEXEC.BAT from the root directory of the boot disk.

If the shell program finds STARTUP.CMD, it bypasses the menu and starts CMD.EXE, which in turn executes the STARTUP.CMD batch file and then enters command-line mode. In this case, the boot-up behavior is very similar to that in DOS. The difference is that from the OS/2 command line, users can display the menu by pressing a hot key; once in the menu, they can return to a previously started instance or start a new instance of a command processor or other program (only one real-mode process can be executed).

When CMD.EXE is started from the menu, it ignores STARTUP.CMD and executes only OS2INIT.CMD (or the batch file named in the PROTSHELL statement). When CMD.EXE is started automatically by the shell, however, it executes only STARTUP.CMD. To perform the same initial processing in both cases, insert a call to OS2INIT into STARTUP; for easier maintenance, do not duplicate the same command sequence in both files.

#### 3 INS' BOO

#### INSTALLING DUAL BOOT

The first requirement for implementing a dual-boot option is to install both operating systems on the same disk. Despite the common file system shared by DOS and OS/2, often these systems cannot coexist because they require identically named files in the root directory. In many OS/2 versions and also in most recent versions of DOS, the two main system files are named

IBMBIO.COM and IBMDOS.COM, regardless of the vendor. The first part of the installation is to modify one of the systems to accept different file names. If your versions already have different file names for each system, then you do not need to perform this part.

The second step, required of all versions, is to allow the coexistence of both DOS and OS/2 versions of CONFIG.SYS and AUTOEXEC.BAT. These names are hard-coded into IBMDOS.COM and COMMAND.COM, respectively, and one of the systems must be modified to recognize different names. COMMAND.COM, the other file name common to both systems, is not hard-coded but specified in the respective CONFIG files.

Once both systems are resident on the same disk partition, the next requirement is a means of asking the user to choose an operating system and of acting on that choice. These functions are performed by the program ASKSYS.ASM (listing 1). After assembling, linking, and converting the program to a .COM file, you must append to it copies of both DOS and OS/2 boot records. Instructions for doing this are provided later on.

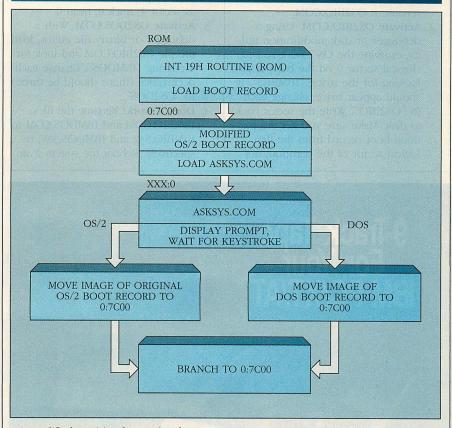
Figure 3 shows the use of ASKSYS.COM in the beginning stages of a dual-boot sequence. A modified OS/2 boot record loads ASKSYS.COM instead of IBMBIO.COM. The OS/2 version of the boot record is used because it already includes logic to find its target file anywhere in the root directory. The ASKSYS program posts a message asking for one of two keystrokes. After receiving one of the correct keys, the program writes a copy of either the original DOS or OS/2 boot record to the boot location and branches to it. The boot-up sequence then proceeds as if the target system were the only one on the disk.

Unlike Microsoft's implementation of dual boot, ASKSYS does not wait forever for a user response. After a certain time, it proceeds to load the default system. You can set this time-out interval by changing the value of the symbol SECONDS, and the default system by changing the value of DEFAULT.

If your OS/2 system does not allow a dual boot, you will need the following tools to modify it to allow the implementation of ASKSYS:

- A debugger or file patching utility for modifying binary files
- A disk-patching utility that can perform I/O in terms of both absolute sectors and files

#### FIGURE 3: Dual Boot Sequence



A modified partition boot record executes a new component, ASKYS.COM, that reads and acts upon a keystroke from the user. It then installs one of two original boot records that completes the starting of either DOS or OS/2.

- · A utility for changing file attributes
- A disk-mapping utility for determining the location of free disk space
- A high degree of competence in using the above
- Cool nerves and a steady hand.

DOS DEBUG or Microsoft's SYMDEB (but not CodeView) are suitable for the first two functions, the Norton Utilities can provide the next two, but the last two are not available commercially.

The procedure for implementing a dual boot describes the addition of DOS to a system on which OS/2 is already installed. The reverse operation—adding OS/2 to a DOS system—is also possible, but it is easier to use the automated installation procedure to install the larger system and then manually add the smaller one.

The following step-by-step instructions are purposely somewhat general; they state *what* must be done without going into great detail on *how*. This is not a project for beginners who need to follow a detailed script, but rather for fairly experienced users who can grasp the reason for each step and

know the details of accomplishing it. At each checkpoint in the procedure, make sure that the system is operational before proceeding with the rest of the installation.

Before starting, back up the boot partition of your hard disk. The procedure then depends on your version of OS/2. If the OS/2 system files have the same names as those in DOS (for example, version 1.0 of OS/2 from IBM and Compaq), you must start with the first phase, beginning at step 1, that modifies OS/2 to use different file names. Otherwise, start with the second phase at step 5. Separate instructions are given later for replacing an existing dual-boot feature with one that includes the time-out capability.

1. Unhide and rename system files.
Boot the system with DOS. Then remove the system, hidden, and read-only attributes from the files IBMBIO.COM and IBMDOS.COM.
Copy them to OS2BIO.COM and OS2DOS.COM, respectively. Check that OS2BIO.COM is contiguous (use CHKDSK); if not, keep making copies under different names until

#### **TECH NOTEBOOK**

- a contiguous one is obtained. Delete all but the contiguous one; rename it OS2BIO.COM.
- 2. Activate OS2BIO.COM. Using a debugger or disk-modification utility, examine the OS/2 boot record (logical sector 0 on the boot drive), looking for the string "IBMBIO". It should appear twice; change each to "OS2BIO". Write the sector back to disk. Make sure you get the partition boot record from the first logical sector of the partition, not
- the disk's master boot record from the first physical sector addressed as sector 1, track 0, head 0.
- 3. Activate OS2DOS.COM. With a debugger or binary file editor, load the file OS2BIO.COM and look for the string "IBMDOS". Change each occurrence (there should be three) to "OS2DOS".
- Does it work? Rename the files IBMBIO.COM and IBMDOS.COM to IBMBIO.SAV and IBMDOS.SAV, respectively. Reboot the system from

the hard drive. If OS/2 starts up, go on to step 5 (you may want to do another backup at this point). If not, boot from a diskette, restore the disk, and decide whether you want to go back to step 1 and try again, or leave well enough alone.

The next stage patches the OS/2 system files so they use startup files CONFIG.OS2 and AUTOEXEC.OS2, allowing them to coexist with the standard DOS startup files CONFIG.SYS and AUTOEXEC.BAT. Start here if your version of OS/2 has system files named differently from DOS system files. If necessary, remove any system, hidden, and read-only attributes from these files. The following instructions assume that the name of the smaller system file is OS2BIO.COM, and that of the larger is OS2DOS.COM; if your version has different names, use those instead.

5. Activate CONFIG.OS2. Boot the system with DOS. Examine the file OS2DOS.COM with a debugger or binary editor. (Despite its name, OS2DOS.COM is an OS/2-style .EXE file, and a DOS debugger will refuse to load it. To circumvent this, rename the file with some other extension.)

Search the file for the string "CONFIG". It occurs over a dozen times, but most of these occurrences are in messages and changing them is optional. The occurrences that must be changed are any data strings used in file I/O functions (in most OS/2 versions, there is only one such occurrence, the last one). In those occurrences, change the extension following the file name from "SYS" to "OS2". Write the patched file; if you changed the name to allow loading with a debugger, rename it with a .COM extension. Rename CONFIG.SYS to CONFIG.OS2.

- Activate AUTOEXEC.OS2. In a similar fashion, patch the OS/2 version of COMMAND.COM to replace occurrences of "AUTOEXEC.BAT" with "AUTOEXEC.OS2". All occurrences should be changed (typically, there are two). Rename AUTOEXEC.BAT to AUTOEXEC.OS2.
- 7. Reorganize OS/2 startup. Move the patched COMMAND.COM to a directory below the root—for example, \OS2. Edit CONFIG.OS2 and change the pathname in the SHELL statement to show its new location. Edit AUTOEXEC.OS2 and insert a SET COMSPEC statement with a full path to COMMAND.COM.



from any 1600 bpi tape into your IBM PC/XT/AT or compatible with Digi-Data's 2000 PC™. Transfer data at over 1 megabyte/minute, in up to 64K blocks with our easy to use DOS/XENIX software. Read entire tapes in EBCDIC or ASCII or select particular files. Backup your data, either in mirror image or by individual files.

Let Digi-Data, with 25 years experience in the manufacture of quality tape drives, resolve your data interchange, disc backup or archival storage needs with a Digi-Data 2000 PC. Call us today at (301) 498-0200.

Digi-Data also offers Series 2000 tape systems for DEC computers. And our GIGASTORE™ tape system provides DEC and IBM PC computers with 2.5 gigabytes of storage capacity.



DIGI-DATA CORPORATION 8580 Dorsey Run Road Jessup, MD 20794-9990 (301) 498-0200 Telex 87-580

... First In Value

In Europe contact: Digi-Data Ltd. • Unit 4 • Kings Grove • Maidenhead, Berkshire England SL6 4DP • Telephone No. 0628 29555/6 • Telex 847720

TM 2000 PC is a trademark of Digi-Data Corporation. PC/XT/AT are trademarks of IBM Corporation.

CIRCLE NO. 121 ON READER SERVICE CARD

## Vitamin

PROFESSIONAL C LANGUAGE FUNCTION LIBRARY

The secret

of your

success!

- Multiple bullet proof overlapping windows ☐ Easy single field or full screen data entry
- ☐ Unlimited data validation
- ☐ Context sensitive help manager
- ☐ Menus like Lotus & Mac
- □ Programmable keyboard handler
- □ Text editor routines
- ☐ Printer output routines

#### Better Applications In Less Time

Fast, flexible, versatile, reliable. Just some of the reasons why serious programmers use Vitamin C in their most important projects. They know using Vitamin C means lightning fast displays, a responsive user interface, professionally crafted C code, and a commitment to technical support.

High level functions provide maximum speed and productivity. Extended versions of these same routines add flexible control over specific details when necessary.

□ 30 day money back guarantee

■ No royalties or runtime fees on applications

☐ Complete library source code included FREE

☐ FREE technical support

☐ FREE BBS at (214)418-0059

☐ Supports Microsoft 5, Quick C, Turbo C, Lattice and others

☐ Optional screen painter/generator

#### Generate Code Inter VERSION!

Speed development even more with VCScreen, our interactive screen painter / code generator. Define windows, boxes, borders, headings, input and output fields. Copy, delete, change, move, even layer objects. Then let VCScreen generate C source code ready to compile and link with the Vitamin C function library.

> New features allow creation of multiple windows, menu systems, global variable main-

tainance, user defined code generation options, and more user configuration options!

#### Versatile Design Keeps You In Control

Options and possibilities rather than limitations and frustrations mean you're always in control. Our versatile open ended design is full of hooks so you can intercept and plug-in your own control functions to easily customize or add features to most routines.

Easily create windows that pop-up, overlap, zoom, move, scroll, hide, show and resize. You'll choose options for titles, borders, colors, scroll bars, virtual size, and more. You can even access any window any time, even if it's hidden or invisible. That's flexibility.

Sophisticated data entry forms become easy with features like unlimited validation, protected, invisible, and scrolling fields, full color control, single and multiple field input, selection sets, even right-to-left numeric input! And, with the context sensitive help system it's easy to provide field specific or other help messages.

Vitamin C's menus are the perfect framework for any application and feature advanced options such as check marks, unavailable items, blank items and separators.

The keyboard handler routines can redefine key assignments, translate keystrokes, even call a function.

Utility routines for time/date management, background processing, and sending windows to a printer.

Thorough documentation with tutorial and reference sections. Reference databases compatible with the Norton Guides Instant Access Program are also available.

#### Users And Reviewers Agree

"Picking the best value package is hard... If you're a source code fanatic like me, Vitamin C is preferable. If you need source code, make sure your wallet is wide open or get Vitamin C." Computer Language, June '87

"Only Vitamin C supports keyboard handlers and keyboard reassignment. Vitamin C provides the most options for menus.' BYTE, October '87

"I trust our review of [Vitamin C] in Computer Language magazine was fair . . . it has become the screen manager package of choice at my firm." Michale Wilson, Wilsoft, Inc.

OS/2, UNIX and Xenix versions now available. Call for prices and details.

Vitamin C.......\$225<sup>00</sup>
Includes source. Specify compiler when ordering.

VCScreen ....... \$14900 Requires Vitamin C library above.

Reference Database... \$5000 Requires the Norton Guides program sold separately.

Requires IBM PC, XT, AT, PS/2 or compatible. Include UPS shipping: \$3 for ground, \$6 for 2nd day air, \$20 for overnight, \$30 if outside U.S. All funds must be in U.S. dollars drawn on a U.S. bank.

**ORDER NOW!** 416-6447



Box 112097 Carrollton, Tx 75011

#### **TECH NOTEBOOK**

8. Does it work? Reboot from the hard disk. If the system does not boot, restore the hard disk and, if you have not yet had enough, retry from either step 1 or step 5.

The final phase installs DOS alongside OS/2; it also installs the ASKSYS program and patches the boot record to load this new program instead of IBMBIO.COM.

- 9. Save a copy of the OS/2 boot record. Boot the system with DOS again. Using a debugger, read in the OS/2 boot record from logical sector 0 of the boot drive, then save it as a 512-byte file under the name OS2BOOT.REC.
- 10. Prepare for installing DOS. Make room for DOS by freeing up two entries at the beginning of the root directory and the sectors at the beginning of the disk's data area (DOS 3.3 needs 44 sectors here). If you started with step 1, simply deleting the files IBMBIO.SAV and IBMDOS.SAV will accomplish this. Otherwise, copy the first two files elsewhere, delete the originals, and rename the copies with the original names. A disk-mapping program is useful for determining when the beginning of the data area is free.
- 11. Install DOS. SYS the boot drive (this replaces the boot record with a DOS version), copy the DOS version of COMMAND.COM to the root directory and external utilities to the \DOS directory, and create CONFIG.SYS and AUTOEXEC.BAT files as appropriate. Reboot to test that the system can start DOS from the hard disk.
- 12. Save a copy of the DOS boot record. Read in the DOS boot record from logical sector 0 into a debugger; write it out as a 512-byte file under the name DOSBOOT.REC.
- 13. Install ASKSYS.COM. Modify ASKSYS.ASM to reflect your prefer-

- ences of time-out delay and default system. Assemble and link it under DOS, then convert it to a .COM file with EXE2BIN. Load ASKSYS.COM into a debugger and make a note of its length. Search for the string "QQQQ"; at the address of the first Q, load DOSBOOT.REC. At an address 200H (512 decimal) greater than that one, load in OS2BOOT.REC. Set the file length back to the original length and write it out to ASKSYS.COM. Make sure that the file is contiguous; if not, refer to step 1.
- 14. Activate ASKSYS.COM. Debug file OS2BOOT.REC. Look for the string "OS2BIO" (it should appear twice). Change each to "ASKSYS" and then write the file to the boot record, sector 0 of the boot drive.
- 15. Does it work? Boot from the hard disk. You should get a message asking for the Enter key to boot OS/2, or the Esc key to boot DOS. If you do not respond during the time-out interval, the system should spontaneously boot into whichever operating system you set as the default.

For an OS/2 system that already implements the dual-boot feature but waits indefinitely for a keystroke (such as Microsoft's version 1.1 in the Software Development Kit), you can easily add the time-out feature. In such a version, most of the work already has been done: DOS and OS/2 are both already present on the disk, and OS/2 is already configured to recognize CONFIG.OS2 and AUTOEXEC.OS2. However, the pre-boot prompt for a keystroke is issued by OS2BIO, not a separate program. If you merely install ASKSYS to execute ahead of OS2BIO. booting OS/2 would require two keystrokes—the first requested by ASKSYS, the second by OS2BIO. The answer is to deactivate the standard dual-boot feature after installing ASKSYS.

To install the enhanced dual-boot feature with time-out on a system that has the feature without time-out, first create copies of both the OS/2 and DOS boot records. To obtain the former, perform step 9. A DOS boot record is saved at offset 3 of file OS2BIO.COM; load this file with a debugger and write out 200H bytes from address CS:103 to file OS2BOOT.REC. Now, install ASKSYS.COM as described in steps 13 and 14 above. Finally, deactivate the original dual-boot process by copying OS2BIO.COM from the original installation diskette to the boot partition of your hard disk.

Once the first copy of a dual-boot version of OS/2 is installed, installation of subsequent copies is simpler. The patching of files in steps 2, 3, 5, and 6 can be avoided simply by copying files OS2BIO.COM, OS2DOS.COM, and COMMAND.COM (the OS/2 version) created in the first installation, provided that the target system has the identical version of OS/2 as the first.

ASKSYS.COM, because it holds boot records for both OS/2 and DOS, is specific to the versions of both operating systems and to the model of hard disk on which it is installed. The final executable form of ASKSYS.COM can be copied only to a system with the identical versions of OS/2 and DOS and with the identical type of hard disk as the system on which ASKSYS was created. Therefore, it is safest to construct ASKSYS on the target system.

The manual procedure described in this article (steps 9 and 12 through 14) may be automated using a program. Readers are invited to submit their solutions. We will publish the best one that is general to all versions of both operating systems, accommodates itself to any model of hard disk, and does not unlawfully disseminate copyrighted code from any vendor's boot record.

```
LISTING 1: ASKYS.ASM
; ASKSYS.ASM - Implements dual-boot w/timeout for DOS & OS/2
; Copyright (C) 1988 Ziff Communications Co. and PC Tech Journal
; Written by Ted Mirecki
; Set default system by value of label DEFAULT
; Set timeout interval by value of label SECONDS
                  13
                                 :Enter key starts OS/2
052
          eau
DOS
          equ
                  27
                                 ;Esc key starts DOS
                                 ;If neither key pressed
DEFAULT
          equ
                  DOS
SECONDS
                  15
                                 ;Timeout interval
          equ
          group
                  code.data
          assume cs:group1, ds:group1
```

| code     | segment | byte public ;establish code segment first       |
|----------|---------|---|
| code     | ends    |   |
| data     | segment | word ;but define data seg first                 |
| time     | dw      | SECONDS*18                                      |
| oldint8  | label   | dword den and an area by and make               |
| int8off  | dw      |   |
| int8seg  | dw      | 0   |
| bootaddr | dd      | 7c00h ;0000:7c00h                               |
| msg\$ db |         | "OS/2 - DOS Dual Boot feature", ODh, OAh        |
|          | db      | "Copyright (C) 1988 Ziff Communications Co. "   |
|          | db      | "and PC Tech Journal", ODh, OAh, OAh            |
|          | db      | "Boot: Enter = OS/2, Esc = DOS", ODh, OAh, 7, 0 |
|          | even    |   |
| dosboot  | db      | 'QQQQ' ;marker for patching in boot rec         |
|          | db      | 508 dup (0) ;space for rest of boot rec         |
| os2boot  | db      | 512 dup (0) ;space for other bootrec            |
| data     | ends    |   |

| code<br>asksys | segment  | byte public   | ;resume same code segment  |
|----------------|----------|---------------|--|
|                | push     | ax            |  |
|                | push     | bx            |  |
|                | push     | cx            |  |
|                | push     | si            | ."   |
|                | push     | di            |  |
|                | push     | ds            |  |
|                | push     | es            |  |
|                | mov      | ax,cs         | ;set ds to code segment  |
|                | mov      | ds,ax         | approved a second secon |
|                | lea      | si,msg\$      | ;get address of message  |
| boot1:         | Lodsb    |               |  |
|                | 00       | al,al         | ;null byte = end of message  |
|                | jz       | boot2         | Deall specified  |
|                | mov      | ah.OEh        | ;write TTY function  |
|                | int      | 10h           | ;Write III function<br>;BIOS video call  |
|                | qmi      | boot1         | ;loop til end of message   |
| boot2:         | int8 = 1 |               | ;address of int 8 vector   |
|                | хог      | ax,ax         | STREET, TREMERVE   |
|                | mov      | es,ax         | ;ES> interrupt table   |
|                | mov      | ax,es:int8    | ;get int 8 address   |
|                | mov      | bx,es:int8+2  |  |
|                | mov      | int8off,ax    | ;save it   |
|                | mov      | int8seg,bx    | a minagement provided  |
|                | lea      | bx, timertick | ;address of timer routine  |
|                | cli      | Market Line   | ;hold off interrupts   |
|                | mov      | es:int8,bx    | ;set timer interrupt   |
|                | mov      | es:int8+2,cs  | PC 9 389 MS Foreau 4 0   |
|                | sti      | sWood vd as   | ;allow interrupts  |
| boot3:         | mov      | ah , 1        | ;get keyboard status   |
|                | int      | 16h           |  |
|                | jnz      | boot4         | ;key pressed if no zero flag   |
|                | стр      | time,0        | ;else test for timeout   |
|                | jg       | boot3         | ;no timeout: test kb again   |
|                | mov      | al DEFAULT    | ;set default keystroke   |
|                | jmp      | short boot5   | ;go process it   |
| boot4:         | XOL      | ah, ah        | ;get the keystroke   |
|                | int      | 16h           | 16 march 300 201 201   |

|            | стр      | al,27            | ;is it escape?                        |
|------------|----------|------------------|---------------------------------------|
|            | je       | boot5            |                                       |
|            | стр      | al,13            | ;is it return?                        |
|            | jne      | boot3            | ;if neither, read kb again            |
| boot5:     | mov      | bx,int8off       | ;get original int 8 vector            |
|            | mov      | cx,int8seg       |                                       |
|            | cli      |                  |                                       |
|            | mov      | es:int8,bx       | ;restore it in vector table           |
|            | mov      | es:int8+2,cx     |                                       |
|            | sti      |                  |                                       |
|            | lea      | si,dosboot       | ; load DOS boot record address        |
|            | стр      | al,27            | ;escape = DOS                         |
|            | je       | boot6            |                                       |
|            | lea      | si,os2boot       | ;else load OS2 boot rec address       |
| boot6:     | les      | di,bootaddr      | ;ES:DI> load addr for boot rec        |
|            | mov      | cx,256           | ;length of boot rec in words          |
|            | rep      | movsw            | ;insert boot rec at boot address      |
|            | pop      | es               | ;exit sequence                        |
|            | pop      | ds               |                                       |
|            | рор      | di               |                                       |
|            | рор      | si               |                                       |
|            | pop      | сх               |                                       |
|            | pop      | bx               |                                       |
|            | pop      | ax               |                                       |
|            | jmp      | cs:bootaddr      | ;branch to boot record                |
| asksys     | endp     |                  |                                       |
| ; Int 8, t | imer ti  | ck hardware inte | errupt, is repointed here.            |
| ; This rou | itine co | unts down a time | e value and chains to original INT 8. |
| timertick  | proc     |                  |                                       |
|            | dec      | cs:time          |                                       |
|            | jmp      | cs:oldint8       |                                       |
| timertick  | endp     |                  |                                       |
| code       | ends     |                  |                                       |
|            | end      |                  |                                       |

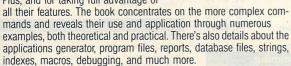
Parameters: 2400/1200/300 bps, no parity, 8 data bits; 1 stop bit.

#### Consult with an IBM expert for under \$25

#### **Advanced dBASE III Plus**

Ken Knecht

Experienced dBASE III and dBASE III Plus programmers will find tips and techniques not found anywhere else for writing better programs, for getting full power from dBASE III and dBASE III Plus, and for taking full advantage of

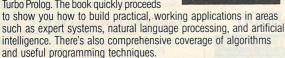


Softbound, 448 pages, \$19.95, 18777-2

#### Prolog Programming in Depth

Michael Covington, Donald Nute, and André Vellino

Experienced programmers new to Prolog will appreciate this fast-paced introduction to Prolog programming language, including Arity Prolog and Turbo Prolog. The book quickly proceeds



Softbound, 496 pages, \$24.95, 18659-8



rolog

Programming

in Depth

#### The Viewport Technician: A Guide to Portable Software Design

Michael Brian Bentley

Designed for software developers, this unique reference shows you how to design, develop, and code portable soft-

ware for Amiga with Intuition, Atari ST with GEM, IBM PC family and compatibles with GEM or Windows, Macintosh, and Apple IIGS. Full of time-saving tips, comparisons, coding hints, and helpful development techniques, *The Viewport Technician* provides the details you need to convert existing programs or develop new software to run on as many machines as possible.

Softbound, 672 pages, \$24.95, 18383-1

#### **Advanced Turbo BASIC**

Ken Knecht

Intermediate to advanced programmers will find valuable tips and techniques in this advanced guide to Borland's Turbo BASIC. Numerous programs supply you with useful tools and utilities you can use to create better programs.

you'll find information about arrays, random access and sequential files, sorting, binary trees, indexes, and more. This easy-to-read, complete book also shows you how to include asssembly language subroutines in your BASIC programs.

Softbound, 352 pages, \$21.95, 38149-8



Available from your local bookstore or contact: Scott, Foresman and Co. Professional Books Group
1900 East Lake Avenue, Glenview, Illinois 60025 (312) 729-3000. Prepayment required. VISA and MasterCard welcome.

helps save time, money, and cut frustrations. Compare, evaluate, and find products.

#### 700 + Programmer's Products

The Programmer's Shop carries every programmer's product for MSDOS, PCDOS, and OS/2. We support CPM, Macintosh, Atari, and Amiga systems. We help you choose the best tools for you. Most popular products are in stock, available for quick delivery.

Are you having a problem finding a unique product?

Call us, we'll find it for you.

Need a Cross Compiler, Translators, or the right Fortran Need a Cross Compiler? Ask us.

Our Services:

- Dealers Inquiry
   Newsletter • International Sales Desk
- Compare Products

- Help Find a Publisher
   Evaluation Literature FREE

- Programmer's Update
- Rush Order
   Over 700 Products
   National Accounts Center

#### RECENT DISCOVERY

VCL Digital Command Language by Boston Business Computing. Emulates VMS DCL System commands, program data, logic flow interactive prompts, extensible command set, line editing, command history, logical, symbol MS \$ 169

| 386 Development Tools         |           |
|-------------------------------|-----------|
| 386 Assembler/Linker          | PC \$ 389 |
| 386 Debug - by Phar Lap       | PC \$ 129 |
| 386/DOS Extender              | PC \$ 919 |
| DESQview PS/2                 | PC \$ 109 |
| F77L-EM - by Lahey            | MS Call   |
| FOXBASE + /386                | PC \$ 419 |
| High C - by MetaWare          | PC Cal    |
| MS Windows/386                | PC \$ 129 |
| OS/286 & 386 by AI Architects | PC Cal    |
| Paradox 386                   | MS \$ 649 |
| PC-Mos/386 - single user      | PC \$ 169 |
| VM/386 multitasker - by IGC   | PC \$ 229 |
| C. Language Campilana         |           |

| C Language-Compilers            |       |      |
|---------------------------------|-------|------|
| AZTEC C86 - Commercial          | PC \$ | 499  |
| C86 PLUS - by CI                | MS \$ | 359  |
| High C Optimizing Compiler      | PC \$ | Call |
| Instant-C/16M                   | PC\$  | Cal  |
| Lattice C - V3.3                | MS \$ | 259  |
| Microsoft C 5.1 - with Codeview | MS \$ | 299  |
| Microsoft Quick C               | MS \$ | 69   |
| NDP C-386 by MicroWay           | MS \$ | 529  |
| Turbo C by Borland              | PC\$  | 67   |
|                                 |       |      |

| C Language-Interpreters            |       |     |
|------------------------------------|-------|-----|
| C-terp by Gimpel - full K & R      | MS \$ | 219 |
| C Trainer - by Catalytix           | PC \$ | 89  |
| Interactive C by IMPACC Associates | PC \$ | 189 |
| Run/C Professional                 | MS \$ | 145 |
| Run/C                              | MS \$ | 79  |
| Turbo C-terp                       | PC \$ | 119 |
|                                    |       |     |

| C Libraries-Files                |           |
|----------------------------------|-----------|
| BTree/Isam - Single user         | MS \$ 99  |
| CBTREE - Source, no royalties    | MS \$ 129 |
| CQL - SQL Source                 | PC \$ 329 |
| c-tree by Faircom - no royalties | MS \$ 309 |
| dB2C Toolkit V2.0                | MS \$ 259 |
| db_VISTA - Source                | MS Cal    |
| r-tree - report generation       | PC \$ 239 |
| Province and the second          |           |

| C Libraries-General          |       |     |
|------------------------------|-------|-----|
| Blackstar C Function Library | PC \$ | 99  |
| C Tools Plus - V5.0          | PC \$ | 99  |
| C Utilities by Essential     | PC\$  | 119 |
| Greenleaf C Sampler          | PC \$ | 69  |
| Greenleaf Functions          | PC \$ | 129 |
| LIGHT TOOLS by Blaise        | PC \$ | 69  |
| Turbo C Tools by Blaise      | PC \$ | 99  |

| C-Screens, Windows, Gra               | phics     |
|---------------------------------------|-----------|
| C Display Manager                     | PC \$ 109 |
| C-Worthy Interface Library            | PC \$ 249 |
| dBASE Graphics for C                  | PC \$ 69  |
| ESSENTIAL GRAPHICS - fast             | PC \$ 235 |
| GraphiC - new color version           | PC \$ 279 |
| Greenleaf Data Windows - incl. source | PC \$ 229 |
| Quick Window/C                        | PC \$ 75  |
| Terminal Mapping System               | PC \$ 279 |
| TurboWINDOW/C - for Turbo C           | PC \$ 75  |
| VC Screen                             | PC \$ 119 |
| View Manager by Blaise                | PC \$ 199 |
| Vitamin C - screen I/O                | PC \$ 159 |
| Windows for C - fast                  | PC Call   |
| Windows for Data - validation         | PC Call   |
| ZView - screen generator              | MS \$ 139 |
|                                       |           |

#### Your Source for Debuggers

Embedded code, C, Asm. Whatever you write, chances are it doesn't run right the first time.

For clear windows on your code, consider these professional tools. Recover from even frozen machines, debug at high level, and keep inter-activity in the debugging process.

Call one of our Tech Reps for help choosing TODAY.

#### Order before 9/30/88 and mention "PT988" for these Special Prices: List Normal SPECIAL

| C Sprite by Lattice       | \$ 175 | \$ 119 | \$ 99  |
|---------------------------|--------|--------|--------|
| DBug III-for dBASE        | \$ 195 | \$ 179 | \$ 159 |
| Periscope I-incl. board   | \$ 455 | \$ 365 | \$ 355 |
| Periscope II-incl. switch | \$ 175 | \$ 139 | \$ 119 |
| Periscope III-IO          |        |        |        |
| MHZ version               | \$1395 | \$1159 | \$1099 |
| SoftProbe II/TX-Rom       | \$ 395 | \$ 345 | \$ 299 |
| TURBOsmith-Turbo Pas      | \$ 99  | \$ 99  | \$ 59  |
|                           |        |        |        |

#### DataBase & File Management

| Advanced Revelation            | PC \$ | 779 |
|--------------------------------|-------|-----|
| CLARION - complete environment | PC    | Cal |
| DataFlex by Data Access        | PC\$  | 595 |
| Magic PC - visual database     | PC\$  | 169 |
| Paradox V2.0 List: \$725       | PC\$  | 499 |
| Paradox Network Pack           | PC\$  | 719 |
| R:Base for DOS                 | PC\$  | 549 |
| XDB-SQL Database               | MS \$ | 449 |

#### **Dbase Language** Clipper compiler dBASE III Plus PC \$ 389 PC \$ 399 PC \$ 649 PC \$ 109 MS \$ 259 PC \$ 419 MAC \$ 299 dBASE III LANPack DBXL Interpreter FORCE III - Dbase compiler FoxBase + - V2.1 FoxBase + /386 FoxBase + Dev't. Pack. for Mac McMax by Nantucket Quicksilver Diamond PC \$ 369

| Dbase Support                     |           |
|-----------------------------------|-----------|
| dAnalyst                          | PC \$ 219 |
| dBFast                            | PC \$ 89  |
| dBC III by Lattice                | MS \$ 169 |
| dBRIEF with BRIEF                 | PC Call   |
| dBug for dBASE                    | MS \$ 179 |
| Documentor - dFlow superset       | MS \$ 229 |
| Flipper Graphics Library          | PC \$ 159 |
| Genifer by Bytel - code generator | MS \$ 249 |
| Integrated Development Library    | PC \$ 129 |
| Networker Plus - by Word Tech     | MS \$ 229 |
| QuickCode III Plus                | MS \$ 189 |
| R&R Report Writer                 | MS \$ 139 |
| Seek-It - Query-by-example        | PC \$ 79  |
| Silver Com Library                | MS \$ 139 |
| Tom Rettig's Library              | MS \$ 79  |
| UI Programmer - user interfaces   | PC \$ 249 |
| Dobuggore                         |           |

| Debuggers   |           |
|---|-----------|
| Breakout - by Essential   | PC \$ 89  |
| CODESMITH - visual  | PC \$ 99  |
| C SPRITE - data structures  | PC \$ 119 |
| DSD87   | PC \$ 79  |
| Periscope II  | PC \$ 139 |
| Periscope II-X  | PC \$ 109 |
| Periscope III - 10 MHZ Version  | PC \$1159 |
| Pfix-86 Plus - by Phoenix   | PC \$ 209 |
| SoftProbe II - embedded systems   | PC \$ 355 |
| THE RESERVE TO SHARE THE PARTY OF THE PARTY |           |

| Editors for Programming   |       |     |  |
|---------------------------|-------|-----|--|
| BRIEF Programmer's Editor | PC    | Ca  |  |
| de - EMACS-style          | PC \$ | 6   |  |
| Epsilon - like EMACS      | PC \$ | 149 |  |
| Emacs by UniPress         | MS \$ | 26  |  |
| Source                    | PC \$ | 89  |  |
| KEDIT - like XEDIT        | PC \$ | 99  |  |
| ME Macro Editor - Source  | PC \$ | 159 |  |
| MKS VI                    | MS \$ | 65  |  |
| PC/EDT - macros           | PC \$ | 229 |  |
| Personal REXX - V1.6      | PC \$ | 99  |  |
| SPF/PC - Version 2.0      | PC \$ | 179 |  |
| Vedit PLUS                | MS \$ | 129 |  |

Call for a catalog, literature, and solid value

800-421-8006

#### THE PROGRAMMER'S SHOP Your complete source for software, services, and answers

5-P Pond Park Road, Hingham, MA 02043 Mass: 800-442-8070 or 617-740-2510 Telex: 671-5348 FAX: 749-2018 7/88

#### RECENT DISCOVERY

Turbo Power Screen by Blaise Computing. Interactive menu-driven screen/field design, keyboard reconfiguration. Intervention routines, virtual screens, range checking. Unlimited windows. Source. Turbo Pascal, MS C, QuickBASIC 4.0. PC \$

| PC \$ | 95  |
|-------|---|
| PC \$ | 229                                       |
| MS \$ | 289                                       |
| MS \$ | 529                                       |
| PC \$ | 165                                       |
| MS \$ | 399                                       |
| MS \$ | 129                                       |
|       | PC \$ PC \$ MS \$ MS \$ PC \$ MS \$ MS \$ |

| Other Products                 |           |
|--------------------------------|-----------|
| ASMLIB - 170 + routines        | PC \$ 12  |
| Back-It by Gazelle             | MS \$ 119 |
| Baler                          | PC \$ 45  |
| CO/SESSION - remote access     | PC \$ 22  |
| Dan Bricklin's Demo II         | PC \$ 16  |
| Disk Technician - smart upkeep | PC \$ 8   |
| Easy Flow V5.0                 | PC \$ 125 |
| Fast Back Plus                 | PC \$ 149 |
| Flash-Up                       | PC \$ 69  |
| Hi-Screen XL                   | PC \$ 129 |
| KeyPilot by Blaise             | PC \$ 49  |
| Link & Locate - intel tools    | MS \$ 309 |
| Mace Utilities                 | MS \$ 85  |
| MathCad                        | PC \$ 279 |
| MKS Trilogy                    | MS \$ 99  |
| PC-Lint                        | MS \$ 99  |
| PC-Metric - analyze complexity | MS \$ 89  |
| PC/Tools Deluxe - by Custom    | PC \$ 69  |
| Plink 86 PLUS - overlays       | MS \$ 275 |
| PVCS Corporate - by Polytron   | PC \$ 339 |
| PVCS Personal - by Polytron    | PC \$ 135 |
| Sapiens Make                   | MS \$ 155 |
| Seidl Version Manager          | MS \$ 269 |
| Source Print - V3.0            | PC \$ 75  |
| Synergy Layout                 | PC \$ 139 |
| Tree Diagrammer                | PC \$ 65  |
| Visible Computer: 8088         | PC \$ 65  |
| WKS Library by Raima           | PC \$ 179 |
|                                |           |

| Translator                     |           |
|--------------------------------|-----------|
| dB2C - Toolkit                 | MS \$ 249 |
| FOR_C - Fortran 77 to C        | MS \$ 659 |
| Promula.Fortran - 66 to C obj. | MS \$ 429 |
| TP2C - by BISS                 | PC \$ 199 |
| Turbo-to-C-Tools - by TGL      | PC \$ 479 |
|                                |           |

| Xenix/Unix                       |        |
|----------------------------------|--------|
| Cobol - by Microsoft             | \$ 639 |
| DOS Merge 386                    | \$ 449 |
| Fortran or Pascal - by Microsoft | \$ 429 |
| FoxBASE+                         | \$ 649 |
| RM/Cobol                         | \$ 959 |
| Xenix Complete System 286        | \$ 979 |

#### **FEATURES**

dBASE IV - features new user interface "Control Center," Multiuser file/record locking, "ANSI + SQL, Query By Example. 255 field records, 99 files open. Parent-child file relations. DOS shell.

Emerald Bay Developer's Kit for C - Access Database Server data management primitives; single, multi-user LAN applications. 386 support. PC Server: \$609, Toolkit: \$429, Both: \$1019

Note: All prices subject to change without notice. Mention this ad. Some prices are specials. Ask about COD and POs. Formats: 3" laptop now available, plus 200 others. UPS surface shipping add \$3/per normal item.

#### OUTFITTING THE END USER

## A Shrink-wrapped Smile

In the long run, software is more a "service" than a "good." The sale or installation is just the beginning of a friendship.



F.C. Coffee

It's hard to talk about the buying and selling of software without sounding like a peculiar hybrid: a mixture of the Uniform Commercial Code and Grimm's Fairy-Tales. On the one hand, we're talking about developing a product that meets—we hope—some need in the marketplace and does so at a competitive overall cost. On the other hand, we're talking about creating and selling little demons that the buyer puts into a magic box, transforming it into a tireless servant that does things the buyer never imagined.

At first, you may consider this "magic" perspective to be fanciful and hardly the viewpoint of any user worth supporting. Think hard, though, about some of the magic boxes you yourself rely on every day. Quickly, now: How does an automatic transmission know that it should downshift when you floor the accelerator? How does a frost-free refrigerator stay that way?

These are useful functions for a dumb box, and we can enjoy most of their benefits without knowing how the miracle happens. For most end users, a good program is one that provides the same kind of carefree functionality.

Today, meeting this goal requires a relationship that continues long after the shrink-wrap is thrown away. It requires a perspective more akin to the sale of services than the sale of goods.

#### **CONTENT VERSUS CHARACTER**

The demons-in-boxes perspective highlights the problem with the recent trend of hanging the *software* label on superficially similar commodities, such as audio and video recordings. The resemblance is misleading.

Both software and recordings are valuable for their information content, rather than for the object that changes hands, but an audio or video recording is not a *program* in the computer sense of the term. Rather, it is a piece of data for use by the hard-wired pro-

gram that is already built into your CD player or VCR. True software provides not just a variation of an already familiar behavior, but rather a whole new *kind* of behavior.

This behavior transplant, if you will, is really what the customer is buying. The package is delivered on a disk, accompanied by a manual, as a matter of convenience and convention. The disk is a carrier of value, not the value itself, no matter what the usual warranty of defect-free media might suggest. You may think you have delivered a working program, but the user sees you delivering a new piece of useful behavior for the user's machine.

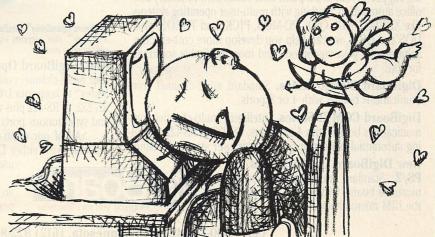
Continued success in the software business—whether with in-house users or with real live paying customersrequires attention to the hidden parts of the transaction. These are what the customer really is buying even if you don't realize that you're selling them. McDonald's restaurants, for example, define their product not in terms of hamburgers and chicken, but in terms of a bundle called "Q.S.C. & V.:" quality, service, cleanliness, and value. Let's apply these fast-food themes to some real-life experiences with commercial PC software, and see if we can hold our own against the Egg McMuffin.

#### **QUALITY: SINE QUA NON**

Excuse the Latin, but *sine qua non* is a terrific phrase, literally translated as "without which not," that perfectly captures the importance of quality in software. English requires many more syllables to make the same point: "If you can't do it well, don't bother."

We expect perfection in computer programs, but getting there is taking a long time. I once reviewed a word processor called Blue that used Ctrl-Break to interrupt an operation in progress—for example, to abort a global replace. Because the program was incredibly slow, the user often got impatient. But beware: if you were in the middle of horizontal scrolling, or another operation that put auto-type keystrokes into the DOS keyboard buffer, Ctrl-Break caused an immediate exit to DOS. Good-bye, file. Quality is hard to define, but this wasn't even close.

By contrast, the initial release of Lotus 1-2-3 was the first piece of PC software that really impressed me as bulletproof. It used Ctrl-Break intelligently and consistently to jump out of the menu system and back to the spreadsheet screen, not to mention pioneering the use of the Esc key as a device for backing out of the menus one layer at a time.



LLUSTRATION • MACIEK ALBREC

#### **OUTFITTING THE END USER**

This last feature is so intuitive, and so deeply embedded in most users' collective unconscious, that I have even seen people try to use Esc as an abort key in DOS. Back before the DOS FORMAT command was revised from "Press any key" to "Press Enter to continue," at least one hard disk got formatted as a result. Lotus did it right; DOS had it wrong.

For that matter, I don't believe I have ever seen a DOS error message leak through 1-2-3's own error-handling routines. Disk errors and "memory full" errors are handled with the same grace as syntax errors in formulas or other local problems.

Today, this is the absolute minimum that a user should demand from an application: it should allow access to operating system utilities such as directories and disk formatting, preferably even to the point of being able to run another program as a child process, but it should completely conceal the underlying system during other operations. (No program failed this last test more spectacularly than the late and unlamented IBM TopView shell, whose manual warned that "system failure may be imminent" if certain error messages were observed.)

I wish I could print the following maxim in 48-point type: *Quality software doesn't crash*. Period. A piece of software that hangs the machine more than once a year (I'll attribute this much to cosmic rays) doesn't belong on your system. This was true enough with single-tasking, single-user systems; it is far more important as an absolute test of unacceptability with more sophisticated operating environments.

#### SERVICE, NOT SLAPSTICK

A few months ago, I ran into a communications program that let me tell it to use COM3, which was supported on the machine in question; it turned out that the program was merely checking to see if I had specified COM1 and was using COM2 if I had not. No developer would ever write software like this if he or she took a service perspective; it would be as inconceivable as telling a waitress that if the customer asks for a drink that isn't coffee, serve tea.

A whole suite of additional examples presents itself in programs that claim they provide the ability to run another program from within an application. Various programs support this feature differently; the variations illustrate the difference between a genuine

commitment to serving the user and a quick and dirty job of adding the feature to the specification sheet.

The easiest way to implement this feature is to use the DOS EXEC facility to run another program "under" the one currently in control. Lotus added this feature to Release 2.0 of 1-2-3. When you call up DOS from within 1-2-3 using the /S option, you get a DOS prompt in place of the application's normal operating screen. When you are done, you type EXIT to return to your spreadsheet.

This approach beats not having the feature at all, but it has several problems. The least excusable nuisance is getting no clue that you are in a child environment. Have you ever had a panic-stricken 1-2-3 user call and say, What happened to all my memory?" I have lost track of the number of times the caller turned out to be using the /S option to run 1-2-3's PrintGraph utility while keeping a spreadsheet in RAM; it's so easy for users to leave Print-Graph and forget that they should type EXIT to get back to their spreadsheet. They just re-run 1-2-3, not realizing that they are running a new copy of the program under the first. This chews up memory in a hurry.

## "The best-engineered Multi-Channel Boards on the market today."

Our words? No. Our customers' words. Probably your words, too, after you've inspected a DigiBoard for yourself.

But just as important as our engineering is our engineering support. From multi-point data collection, to factory and office automation, working with multi-user operating systems like XENIX, UNIX, QNX, PC-MOS, PICK, and THEOS, plus DOS and OS/2, we can help you develop more cost-effective solutions for your customers. And more profitable solutions for you.

**DigiBoard COM-X Series.** Standard multi-channel communications boards with 4 or 8 ports.

**DigiBoard COM-Xi Series.** Intelligent multi-channel communications boards with 4 or 8 ports, RS-232 or RS-422, providing substantial performance increases over standard boards.

New DigiBoard COM-X Series for PS/2. Standard multi-channel communications boards with 4, 8 or 16 ports for the IBM micro-channel.



New. DigiBoard OpenEnder<sup>™</sup> Series for PS/2. Intelligent multi-channel communications boards with plug-in I/O Mates<sup>™</sup> to keep your I/O options wide open. Options include RS-232, or RS-422 plus various combinations of asynchronous and synchronous ports.

All of our multi-channel communications boards are available with either DB25 or RJ45 connectors to suit the

users' exact requirements.

Software drivers and flexible utilities are provided free with each board for most popular operating systems.



Call 1-800-344-4273. In Minnesota, (612) 922-8055.

# THERE ARE FOUR WAYS TO MEASURE THE SPEED OF A LAN.



#### Ours only wins in three of them.

#### 1. How fast does it install.

We have no competition in this category. LANLink 5X installs in about fifteen minutes, and it doesn't take a technician to do it. Since LANLink 5X uses standard parallel or RS-232 serial ports, installing a network means little more than connecting the cable and loading the software.

With hardware LANs, installation can easily take two daysone to set it up and one to tweak it. And it also takes someone who really knows what he's doing. That is, someone expensive.

#### L. How fast does it transmit.

Okay, this is the category we don't win; the hardware LANs are generally a little quicker. At least, they are under optimal conditions, which is how they rate themselves.

But LANLink 5X is pretty quick, too. At half a megabit per second, it's way out ahead of any other software LAN, and right at the heels of the hardware types. Which, of course, are far more expensive.

#### **5.** How fast does it maintain.

The real cost of a network is not so much the initial price as it is the continuing outlay for maintenance–adapting it to changing needs. That's something LANLink 5X does practically on its own.

Running under PC-MOS/386™ or PC-DOS, it turns your server PC into a multi-tasking controller, driving a truly expandable LAN that is easily and quickly ungradable

is easily and quickly upgradable.

A hardware LAN, on the other hand, becomes obsolete as new technology is introduced. And, to keep the network up and running as applications change, you need the attentions of a technician, on a continuing basis. A very well-paid technician.

#### 4. How fast can you pay for it.

Now we've arrived at the bottom line, where LANLink 5X is toughest to beat. You can install a five-user LANLink network for about the same cost as the LAN board in a board-driven network. On top of that, factor in what you save on installation and maintenance time, and the difference is pretty dramatic.

LANLink 5X is available immediately, and it comes with a moneyback guarantee. Its price of \$595 includes a server and a satellite module plus the network operating

system. Additional satellites are available for \$125.

For complete details on the fastest software-driven network available.

able, call 800-451-LINK.

LANLink 5X. Because three out of four ain't bad.

THE SOFTWARE LINK

3577 Parkway Lane, Norcross, GA 30092 (404) 448-5465 FAX (404) 263-6474

CIRCLE NO. 196 ON READER SERVICE CARD

#### **OUTFITTING THE END USER**

WordPerfect appears to have the simplest answer to this problem. It simply modifies the PROMPT string in the copy of the DOS environment that gets passed to the child process. When you go out to DOS under WordPerfect, your DOS prompt reminds you that you are in a child session and should type EXIT to return. Very simple.

So simple, in fact, that you can add this feature to any application by putting a command to change the prompt in the batch file that starts the program. You can reset the prompt to your usual format—\$P\$G or whatever—before returning to DOS. For example, part of the batch file that runs Ashton-Tate's Framework on my system says:

CD \FW
Prompt {FW}\$P\$G
FW
Prompt \$P\$G
CD\

When I open a DOS window under Framework, even if I zoom the window to full screen, that little {FW} prefix never lets me forget my situation.

Fixing the prompt does nothing, of course, to correct the other problem with the simple DOS EXEC solution—

namely, that you may wind up sitting in a neatly labeled child session with too little memory to be useful. This is why it is important for developers to: (1) minimize an application's use of memory in the first 640KB when any kind of expanded memory is available; and (2) provide a user-selectable roll-out facility that temporarily unloads as much of the code as possible when the user enters a child process.

First-rate products go out of their way to make life easier for me, even when I'm not using them directly but rather as shells for other programs. By contrast, an application that claims to provide DOS access but strands the user in a 128KB space with no clue to the way back home, brings to mind a bunch of little people behind the screen doubled up with laughter and velling, "You asked for it, you got it!" All we need to complete this scene is a custard pie exploding in the user's face. This is slapstick comedy, not service to the customer, and it has no place in a professional environment.

#### **KEEPING IT CLEAN**

Moving on to the "clean" piece of the Q.S.C. & V. package, think about the difference between a merely "sanitary"

restaurant and one that sparkles from every visible surface. It's a difference that you notice immediately, but one that comes only from the totality of dozens of individually tiny details.

Quarterdeck's DESQview is an example. When first installed, it searches through your disk to find the applications that it "knows" how to handle right out of the box. The first time you bring up the DESQview windowing environment, most of your mainstream applications are right there in the master menu—ready to go. The effect is uncanny and builds a positive feeling toward the system from that moment forward. Quarterdeck didn't have to take this extra step, but it sure makes a great first impression.

Never underestimate the importance of providing that early gratification to the user, whether novice or expert. McDonald's fare is consumed immediately—don't expect your users to be any more patient. The novice is frightened by labor-intensive and error-prone configuration procedures, the power user merely annoyed, but either one is quite likely to dismiss the product as not worth the trouble. Remember that anyone with a machine on his or her desk today probably has figured out reliable ways to do the truly essential tasks-your program must make life easier from the moment its opening screen appears.

In your efforts to make those first few minutes pleasant, don't fall into the trap of making a product that is easy to learn but almost impossible to use. DESQview avoided that trap; many people never notice that if you rattle off its one-key shortcut commands in quick succession, the intermediate menus never appear. If you pause for even a moment, the menu is there at once—a nice piece of coding, but one that never would have been conceived without some thought about what the user would find most convenient.

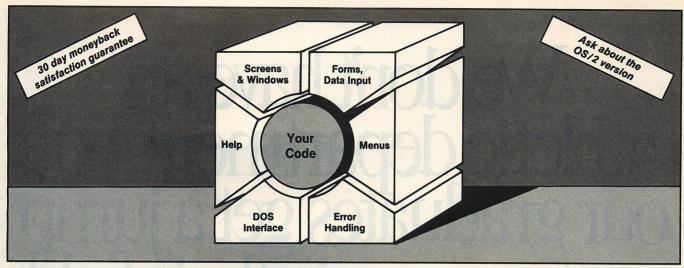
By contrast, IBM's TopView always displayed (slowly) each level of hierarchical menu before it would accept the corresponding command. A detail within a detail, perhaps, but one with huge impact on the user's continuing satisfaction as proficiency increases.

Sometimes, several generations of competing attempts are needed to arrive at the optimal compromise. Back in the spreadsheet arena, 1-2-3 has a feature that seems nice at first: it automatically recognizes a label entry if the first character is alpha, while assuming that an initial number or operator indi-

## DELIVER PROFITABLE INTERACTIVE VOICE APPLICATIONS QUICKLY AND EFFICIENTLY WITH POLYTON

- The nitaAudioboard is a PC-compatible peripheral card that puts you to work in the productive MS/DOS marketplace.
- The nitaTools software with its full-function, C-language applications interface lets you develop targeted, high-fidelity voice applications as you shorten your development cycle.





C-Worthy Interface Library helps you smoothly pull together all aspects of an excellent Human Interface.

#### C Programmers: Wrap an Exciting, Bullet-Proof Interface Around Your Code Quickly.

#### A Complete Solution... C-Worthy® Interface Library

The only human interface package you need. That's what our customers are telling us. One early adopter, Novell, Inc. uses it exclusively in the development of their NetWare® Utilities, which reach over 500,000 users. You see, C-Worthy Interface Library is the only library available to handle every aspect of your program's human interface, all in one package. Now your programs will have a consistent look and feel. You no longer have to integrate pieces of libraries from different manufacturers.

As important as you know users are, you often don't have the time to heavily invest in writing routine code. And that's OK, because with over 400 tight, ready-to-use functions, C-Worthy Interface Library takes care of the tedium and lets you spend your time doing what you enjoy. Concentrate on the heart of your application — features that make it unique, special. Let C-Worthy Interface Library do your:

- Menus
- Error Handling
- DOS Interface
- Context Sensitive Help
- Screens, Windows
- Forms, Data Input (optional)

You control color, size, border, location, etc. And if there's anything you want to change, you can. Source is available to provide you with the flexibility you need. And you can distribute your applications freely, with no royalties.

C-Worthy Interface Library requires hard disk media with 256K RAM. MSDOS 2.0 + and IBM PC, or compatible, TI Professional, NEC APC III, or VICTOR 9000. C-Worthy is a registered trademark of Custom Design Systems, Inc.

#### **Tech Specs**

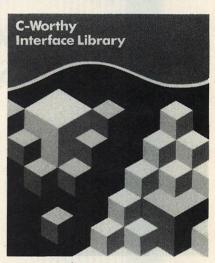
- Compilers: Microsoft 3.0+, Quick, Turbo, Lattice. All models.
- 350+ functions written in C, 75+ in Assembler.
- Menus: Fully support pop-up, Lotus style, MS Windows style (pull-down), pull-up.
- Errors: DOS, program, and user.
- DOS Interface: 62 functions. File handling, dir. and drive management, date & time conversion, wildcards, more.
- ► Help: System and context sensitive.
- Screens: Screen display, color palettes, save, restore, scroll, more.
- ➤ Windows: Exploding, tiled, pop-up, overlapping. Direct video access and virtual. Up to 50 active at any time.
- Keyboard Handling: Regular, function, interrupt, background procedures.
- Editing: String and word wrap text.
- ➤ Form Interface Library: 118 functions. Over 15 field types, and user definable field types. 3 levels of data validation: type, multiple field ranges, optional validation procedures. Hide, lock, or secure a field. Optimal field movement.
- Foreign Languages: All text messages in separate files for easy translation.
- Compatible with MS Windows.
- ➤ OS/2 version available.
- ➤ Machines: Autodetect for MDA, CGA, EGA, VGA, TI, AT&T, Victor.
- ➤ No royalties.

"I heartily recommend this package," — David A. Schmitt, president, Lattice, Inc. Over 1,500 developers in 16 countries already use it.

#### Thorough Documentation

Indexed alphabetically and by category, the 700+ page Reference Guide includes for each function: an example, description, calling conventions, return values, and related functions. The 250 page User's Guide gets you going with its tutorial and "Getting Started" sections.

Outrageous Demo. Call for C-Worthy's FREE Sample Application Kit. No strings attached.



| C-Worthy Interface Library:        |        |
|------------------------------------|--------|
| Object only                        | \$ 195 |
| Form Interface Library add-on      |        |
| Object with Forms                  | \$ 295 |
| Object with Forms & Library Source | e\$495 |

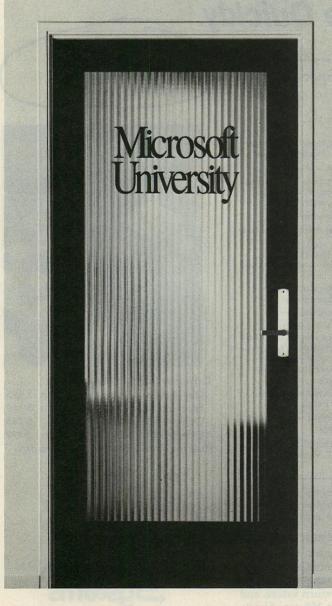
Please specify compiler and version when ordering.

To Order Call (800) 821- 2492 in MA (617) 337-6963



541-L Main Street, Suite 410
South Weymouth, MA 02190
CIRCLE NO. 166 ON READER SERVICE CARD

# We don't have an athletic department, but our graduates get a jump on everyone in their field.



Microsoft University brings the institution of higher learning to an even higher plane. It's a place where programmers and developers learn about Microsoft systems software straight from the source: from instructors with firsthand knowledge of what drives Microsoft systems software.

Our instructors take you through intense, hands-on courses that concentrate on the development of Microsoft \*OS/2 and Microsoft Windows applications.

You gain insight and expertise writing software in environments such as MS° OS/2, MS OS/2 LAN Manager and MS OS/2 Presentation Manager. As well as Microsoft Windows/286 and Windows/386.

Courses take place in a lab setting so you not only learn theory, you also gain practical experience by actually writing software. And courses are offered for different levels of expertise.

To receive more information and a copy of the Microsoft University catalog, call 206-882-8080! And if you or your team cannot attend classes at one of our facilities, be sure to ask about our on-site customer training program or video training course that is available.

Either way, we're going to make sure you learn the nuts and bolts of Microsoft systems. So you can make great leaps in your field.

Microsoft. University

#### **OUTFITTING THE END USER**

cates a formula—but watch a novice user try to put an address such as "123 Main Street" into a spreadsheet cell. Microsoft went to the opposite extreme, requiring an equal sign as an explicit indicator of a formula in Excel. When I enter a formula, I often forget this and have to go back and add it.

Perhaps the ideal solution is the one described on Ashton-Tate's Compu-Serve Forum as part of its upcoming Framework III: a Data Entry option on the cell-formats menu tells the system to assume that any entry made to that cell is a label. This is the same as putting label-prefix characters in every cell of a range in 1-2-3, but not nearly as cumbersome. It solves the problem with minimum recurring effort: it lets you say something once, instead of requiring you to tell the system every time you make an "unusual" entry.

#### PRICE VERSUS VALUE

I don't know who started the myth that software has to be priced in proportion to the cost of the associated hardware, but I wish the idea would go away. For example, IMSL, the publisher of the definitive FORTRAN libraries for scientific and technical computing, charges more than three times as much for its Sun workstation version as for its PC version—for a product whose principal selling point is that it is functionally identical on any supported machine.

A dramatic example is the unfortunate fate of Interleaf Inc., whose earnings recently dropped 92 percent from previously forecast levels. Many believe that the principal cause was the May 27th shipment of a \$2,500 PC version of the Interleaf Publisher. On a suitably powerful PC, this is functionally comparable to versions costing up to \$16,000 on workstation-class machines.

The user community has to bear some of the blame for pricing discrepancies. Look at what has happened to Borland: by many accounts, its Turbo C is a plausible competitor for Microsoft's full-blown C compiler, yet almost every review compares it with Microsoft's more limited QuickC because they fall into the same price range. In the same vein, Borland had to *raise* the price on its Reflex data manager before anyone would take it seriously. I've heard of getting what you pay for, but the software marketplace seems to have turned this into "if you pay for it, you'll get it."

Four years ago, I told a major developer: "Don't tell us it costs you a fortune to build market awareness of your product: the only cost should be

in getting evaluation units into the hands of reputable reviewers and volume purchasers. If those people don't like it, no amount of advertising will save you; if they like it, you don't need advertising." I believed it then, and with the increasing rigor and thoroughness of comparative product reviews, I believe it even more today. To persuade the development side of the industry completely, however, the user segment must prove that it can perceive the value of a product without looking at the price tag.

Much of that value comes in the form of after-sale support, and the intelligent developer capitalizes on the free help that users so readily give each other. An on-line forum, of which there are many examples on Compu-Serve, is an excellent way to do this. I was using Framework on an EGA one day and wondered if anyone had built a screen driver that would use the 43line text mode: I opened a communications frame, dialed up the Ashton-Tate Forum, found exactly what I needed, downloaded it, and had it installed and running so quickly that I probably still would have been on hold with conventional telephone support. That's what I call a continuing, working relationship

with a product and its manufacturer. Support via an 800 number also is becoming an expected part of the package for top-of-the-line applications.

#### SAY "CHEESE"

Do the systems you develop and/or deliver tell your users that you are glad they are there? Do those systems seem actively interested in making life easier in every way that's even remotely related to the task being performed? Or do they emulate the competent but undesirable employee whose favorite phrase is "That's not my job"?

Producing a shrink-wrapped smile is a whole lot harder than delivering a stainless-steel subroutine. But would you rather sell your customers a new friend who will cultivate a long relationship, or sell them just another tool that gets thrown on the shelf with the rest? If you want to stay in business for a while, introducing your users to lots of smiling friends is the best way to make that happen.

Peter C. Coffee is managing partner of SolveWare, a developer and business computing consultant, and is active in AI and distributed computing applications for aerospace and educational clients.







Instant access to the latest products and services is just a phone call away

## PARADISE PRICES 1-800-445-7899

Brief w/dBrief

EDIX Epsilon KEDIT



#### CALL PROGRAMMERS PARADISE TODAY and discover our commitment to bringing you the best software at the best

prices. You'll also find software pros to help you select the product that you need plus immediate shipment on our stock of 1000 products and a 30-day money back guarantee. Paradise is ready and waiting for you.

| 386 SOFTWARE                  |       |
|-------------------------------|-------|
| 386-to-the-Max                | 66    |
| FoxBASE + /386                | 459   |
| Microport System V/386 (comp. | ) 759 |
| MS Windows/386                | 130   |
| NDP C or Fortran-386          | 529   |
| Pharlap 386/ASM/Link          | 409   |
| SCO Xenix System V 386 (comp. | 1279  |
| VM/386                        | 182   |
| ASSEMBLERS/LINKERS            | 0.00  |
| Advantage Disassembler        | 279   |
| MS Macro Assembler            | 99    |
| Optasm                        | 109   |
| Plink86plus                   | 279   |
| BASIC                         |       |
| Flash-Up                      | 80    |
| MS Basic Compiler 6.0         | 189   |
| MS QuickBASIC                 | 69    |

#### **TROPICAL** TREATS

Greenleaf has added several new products to its outstanding line of development tools including a 200 functions mathematics library and a new interactive screen generator/editor for Greenleaf DataWindows. Call us to order any of these or other Greenleaf Software Products.

| Greenleaf Functions     | 155 |  |
|-------------------------|-----|--|
| Greenleaf Comm. Library | 169 |  |
| Greenleaf DataWindows   | 209 |  |
| DataWindows for OS/2    | 279 |  |
| TurboFunctions          | 109 |  |
|                         | 239 |  |
| SuperFunctions NEW      | 265 |  |
| Makeform NEW            | 125 |  |
|                         |     |  |

| QuickPak                      | 60         |
|-------------------------------|------------|
| Turbo Basic                   | 69         |
| Turbo Basic Toolboxes         | 69         |
| C COMPILERS/INTERPRE          | TERS       |
| C-Terp                        | 232        |
| Lattice C                     | 272        |
| Microsoft C                   | 289        |
| Quick C                       | 69         |
| Run/C Professional            | 159        |
| Turbo C                       | 69         |
| CLIBRARIES                    |            |
| C Asynch Manager              | 137        |
| C Tools Plus/5.0              | 101        |
| C Utility Library             | 125        |
| Essential Comm Library        | 125        |
| Communications Plus           | 199        |
| Greenleaf Comm Library        | 169        |
| Greenleaf Functions           | 155        |
| PforCe<br>Timeslicer          | 215<br>279 |
| Turbo C Tools                 | 101        |
|                               | 101        |
| COBOL                         |            |
| Micro Focus COBOL/2           | 733        |
| Microsoft COBOL               | 452        |
| Opt-Tech Sort<br>Realia COBOL | 105        |
| Realcics                      | 794<br>799 |
| SCREENIO                      | 382        |
| MUBIL DOUBLE                  | 302        |
| DBASE TOOLS                   | 200        |
| Clipper daylana Inemela       | 399<br>395 |
| FoxBASE+                      | 269        |
| Hi-Screen XL                  | 129        |
| R & R                         | 139        |
| Say What?!                    | 45         |
| DEBUGGERS                     |            |
| Periscope I                   | 373        |
| Periscope II                  | 141-       |
| Pfix 86 Plus                  | 215        |
| DISK/DOS/KEYBOARD             |            |
| DIGIT DOGINE I DOGINE         |            |

UTILITIES Command Plus V. 2.0 Disk Optimizer

Fastback Plus Norton Commander Norton Utilities Advanced PC Tools Deluxe

| Norton Editor                                 | 70         |
|---|------------|
| PC/EDT+                                       | 269        |
| SPF/PC  | 185        |
| FILE MANAGEMENT                               |            |
| Btrieve                                       | 185        |
| Xtrieve<br>Report Option                      | 189<br>109 |
| Cbtree  | 141        |
| c-tree  | 318        |
| r-tree<br>dBC III                             | 241<br>172 |
| dB_Vista or dB_Query                          | CALL       |
| Informix Products                             | CALL       |
| FORTRAN                                       |            |
| Lahey Personal FORTRAN 77                     | 86         |
| MS FORTRAN<br>RM/FORTRAN                      | 289<br>479 |
|   | 4/9        |
| GRAPHICS Essential Craphics                   | 220        |
| Essential Graphics<br>HALO '88                | 229<br>229 |
| HALO '88 (5 Microsoft Lang.)                  | 399        |
| MetaWINDOW Plus                               | 232        |
| OBJECT-ORIENTED                               |            |
| PROGRAMMING                                   |            |
| Actor   | 423        |
| Advantage C + + PforCe + +                    | 479<br>215 |
| Smalltalk/V                                   | 85         |
| Application Packs                             | 45         |
| Smalltalk/V286                                | 169        |
| OPERATING SYSTEMS                             |            |
| Microport 286 DOS Merge<br>Microport Sys V/AT | 129<br>469 |
| SCO Xenix System V (comp.)                    | 999        |
| SCO Xenix System V (comp.) Wendin-DOS         | 80         |
| m as dilw sHt see                             |            |
| lei C all Forman                              |            |
| is. especially and clive                      | DISUBIL    |
| ( 1000 BRAND NAME                             | 1          |
| PRODUCTS IN                                   |            |
|   | 1          |
| STOCK   | 1          |
| 12  | Jan H      |
|   |            |
| PASCAL COMPILERS                              |            |
| Microsoft Pascal                              | 189        |
| Turbo Pascal                                  | 69         |
| Turbo Pascal Dev. Lib.                        | 289        |
| TURBO PASCAL ADD-ON                           | 1S         |
| T-Debug Plus                                  | 39         |
| w/Source<br>Turbo Asynch Plus                 | 80<br>101  |
| Turbo Halo                                    | 80         |
|   |            |

| Microsoft Pascal           | 18  |
|----------------------------|-----|
| Turbo Pascal               | 6   |
| Turbo Pascal Dev. Lib.     | 28  |
| TURBO PASCAL ADD-O         | NS  |
| T-Debug Plus               | 3   |
| w/Source                   | 8   |
| Turbo Asynch Plus          | 10  |
| Turbo Halo                 | 8   |
| Turbo Magic                | 9   |
| Turbo Pascal Toolboxes     | 6   |
| Turbo Professional 4.0     | , 8 |
| SCREENS/WINDOWS            |     |
| Greenleaf DataWindows      | 20  |
| Microsoft Windows          | 6   |
| MS Windows Development Kit | 31  |
| Panel Plus                 | 39. |
| Turbo Power Screen         | 10  |
|                            |     |

Vitamin C.

VC Screen

Windows for Data

| J        | TIU- IUUU                      |        |
|----------|--------------------------------|--------|
|          | ADDITIONAL PRODUC              | TS     |
| CALL     | Carbon Copy Plus               | 142    |
| CALL     | Dan Bricklin's Demo Prog. II   | 179    |
| 169      | Eureka                         | 119    |
| 151      | FLOW CHARTING II               | 205    |
| 120      | MathCad                        | 279    |
| 70       | MS OS/2 Prog. Toolkit          | 239    |
| 269      | Norton Guides                  | 69     |
| 185      | PC-Lint                        | 101    |
|          | PC Scheme                      | 86     |
| 0.007.00 | Polytron PVCS                  | CALL   |
| 185      | Pre-C                          | 159    |
| 189      | Source Print                   | 80     |
| 109      | Tree Diagrammer                | 70     |
| 141      | persons and hope YAV pelt on h | 015000 |
| 318      | HOW WE WORK                    |        |
| 241      |                                |        |
| 172      | PHONE ORDERS                   |        |
| CALL     | Hours 9 AM - 7 PM EST, We      | oildas |
| CALL     |                                |        |
|          | accept MasterCard, Visa, A     | meri-  |
| 86       | can Express. Include \$3.95    | per    |
| 00       | itom for chinning and hand     | 11:    |

item for shipping and handling. All shipments by UPS ground. Rush service available, ask for rates when you order.

MAIL ORDERS

POs by mail or fax are welcome. Please include phone number.



RETURN POLICY

Our "No Hassle" policy means if you're not satisfied with a product from Programmer's, simply return it within 30 days for a refund. Some manufacturer's products cannot be returned once disk seals are broken, so check before you buy.

#### INTERNATIONAL SERVICE

Take advantage of our International business number for details on export charges and exchange rates. Payments should be made in U.S. dollars.

DEALERS AND CORPORATE ACCOUNTS Call and ask for our catalog and

special volume discounts. UNBEATABLE PRICES We'll match lower nationally

advertised prices. In NY: 914-332-4548

Customer Service: 914-332-0869 International Orders: 914-332-4548 Telex: 510-601-7602 Fax: 914-332-4021

Call or Write for Latest Free Catalog!

1-800-445-7899



A Division of Magellan Software Corp 55 South Broadway, Tarrytown, NY 10591



#### Mainframe Power for your PC!

If you need or are accustomed to the throughput of a 32-bit mini, including any of DEC's VAX series, MicroWay has great news for you. The combination of our NDP compilers and our mW1167 numeric coprocessor gives your 386 PC, VAX speed! If you don't own a 386 PC, we provide a number of economical

PC and AT upgrade paths.

Many of our NDP Fortran-386 users are reporting turn around times that are two to six times faster than their VAX. The exact times are a function of the VAX processor being used, the speed of the 386, the number of users being served by the VAX, and the coprocessor being used with the 386. There are currently over 400 developers using our NDP tools to port 32-bit applications. To help the 386/1167 engineering standard emerge, MicroWay is co-marketing several mainframe applications that have been ported by our customers. In addition, this ad inDr. Robert Atwell, a leading defense scientist, calculates that NDP Fortran-386 is currently saving him \$12,000 per month in rentals of VAX hardware and software while doubling his productivity!

Fred Ziegler of AspenTech in Cambridge, Mass. reports "I ported 900,000 lines of Fortran source in two weeks without a single problem!" AspenTech's Chemical Modeling System is in use on mainframes worldwide and is probably the largest application to ever run on an Intel processor.

Dr. Jerry Ginsberg of Georgia Tech reports "My problems run a factor of six faster using NDP Fortran-386 on an mW1167 equipped 386/20 than they do on my Micro VAX II."

troduces the first of many utilities that will ease the porting of your favorite in-house programs. These include tools like NDP-Plot, which provides CalComp compatible screen and printer graphics, and NDP Windows. MicroWay has mW1167 boards in stock that

run on the Compaq 386/20, IBM PS2/80, Tandy 4000, AT&T 6386, Acer 386/20, Everex Step 386/16(20), H.P. Vectra RS/16(20) and others. We now have a new board for the Compaq 386/20 which combines an 1167 with VGA support that is register compatible with IBM the "SlotSaver". It features an extended 800x600 high res mode that is ideal for 386 workstations.

Finally, we still offer the 16-bit software and hardware which made us famous. If you own a PC or AT and are looking for the best 8087/80287 support on the market, call (508) 746-7341 and we'll send you our full catalog.

#### 32-Bit Compilers and Tools

NDP Fortran-386™ and NDP C-386™ Compilers generate globally optimized mainframe quality code and run in 386 protected mode under PharLap extended MS-DOS, UNIX, or XENIX. The memory model employed uses 2 segments, each of which can be up to 4 gigabytes in length. They generate code for the 80287, 80387, or mW1167. Both compilers include high speed EGA graphics extensions written in C that perform BASIC-like screen operations ...... \$595 each

- NDP Fortran-386™ Full implementation of FORTRAN-77 with Berkeley 4.2, VAX/VMS and Fortran-66 extensions.
- NDP C-386™ Full implementation of AT&T's PCC with Microsoft and ANSI extensions.

#### NDP Package Pricing:

387FastPAK-16: NDP Compiler, PharLap, and 80387-16 Coprocessor . . . . . . \$1299 1167FastPAK-16: NDP Compiler, PharLap, and mW1167-16 Coprocessor .....\$1695

NDP Windows™—NDP Windows includes 80 functions that let you create, store, and recall menus and windows. It works with NDP C-386 and drives all the popular graphics adapters. Library ..... \$125, C Source ..... \$250

NDP Plot™ — Calcomp compatible plot package that is callable from NDP Fortran. It includes drivers for the most popular plotters and printers and works with CGA, Hercules, EGA 

NDP/FFT™ — Includes 40 fast running, hand coded algorithms for single and double dimensioned FFTs which take advantage of the 32bit addressing of the 386 or your hard disk. Callable from NDP Fortran or NDP C with 1167 and 387FFT for 16-bit compilers . . . . . . . . . . . \$250

387BASIC™ — A 16-bit Microsoft compatible Basic Compiler that generates the smallest .EXE files and the fastest running numeric code on the market. . . . . . . . . . . . . . . . . . \$249

#### MicroWay " 80386 Support

#### **Parallel Processing**

Monoputer™

The world's most popular Transputer development product runs all MicroWay Transputer software using either a T414 or T800. The T800 processor has built-in numerics and provides performance comparable to an 80386 running at 20 MHz with an mW1167. The new 3L Parallel C and Fortran Compilers makes this an especially attractive porting environment. Can

be upgraded to 2 megabytes.

Monoputer with T414 (0 MB) . . . . \$995 Monoputer with T800 (0 MB) ...... \$1495

Quadputer™

This board for the XT, AT, or 386 can be purchased with 2, 3 or 4 Transputers and 1, 4 or 8 megabytes of memory per Transputer. Two or more Quadputers can be linked together to build networks with mainframe power which use up to 36 Transputers. One customer's realtime financial application has gone from 8 hours on a mainframe to 16 minutes on a system containing five Quadputers.... from \$3495

Transputer Compilers and Applications
MicroWay and 3L offer Parallel languages for the Monoputer and Quadputer.

MicroWay Parallel C . . . . . . . . . . . . . . . . \$595 MicroWay Occam2 . . . . . . . . . . . . . \$495 3L Parallel Fortran .....\$895 μField — A specialty finite element analysis package targeted at Transputer networks. Ideally suited to take advantage of the 6 Megaflop speed of the Quadputer. . . . . \$1600

> Call (508) 746-7341 for our free catalog!

#### Numeric Coprocessors

| mW1167™ — Built at MicroWay using Weitek        |
|---|
| components and an 80387 socket.                 |
| mW1167-16\$995                                  |
| mW1167-20\$1595                                 |
| mW1167/VGA-20 "SlotSaver" \$1995                |
| 8087  |
| 8087-2\$154                                     |
| 80287-8\$239                                    |
| 80287-10\$295                                   |
| 80387-16\$450                                   |
| 80387-20\$675                                   |
| 287Turbo-12 (for AT compatibles)\$450           |
| DRAM CALL                                       |
| (All of our Intel coprocessors include 87Test.) |

#### **PC and AT Accelerators**

MicroWay builds a number of 8086 and 80286based PC accelerators that are backed up by the best customer support in the industry.

Number Smasher™ (8087 & 512K) . . \$499

FastCACHE-286/9 MHz . . . . \$299 FastCACHE-286/12 MHz . . . . . . . . . . . . . . . \$399 SuperCACHE-286/12 MHz .....\$499 Intel Inboard™ PC (1 MB) . . . . . . . . \$950

#### Intelligent Serial Controllers

MicroWay's AT4™, AT8™, and AT16™ are the fastest 80186-based intelligent serial controllers on the market. They come with drivers for UNIX, XENIX, and PC MOS.

AT4 ... \$795 AT8 ... \$995 AT16 ... \$1295

#### 32-Bit Applications

COSMOS-M/386 — SRAC's finite element package for the 80386 with an 80387 or mW1167 provides mainframe speed and capacity. Turn around times rival the VAX 8650 and are 6 to 15 times that of an AT: from \$995

PSTAT-386 — This mainframe statistics package has been used by government and in-dustry for 20 years. The full version was ported. Requires 4 to 6 megabytes of memory: \$1495

NDP/NAG™ — Features a library of 800 engineering and scientific numerical algorithms.
Callable from NDP Fortran .......\$895



#### The World Leader in PC Numerics

P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341 32 High St., Kingston-Upon-Thames, U.K., 01-541-5466 St. Leonards, NSW, Australia 02-439-8400

#### TECH MARKETPLACE

THE COMPREHENSIVE GUIDE TO PRODUCTS AND SERVICES FOR THE MS DOS MARKET

#### PRODUCT CATEGORIES

| HARDWARE                | 156-158           |
|-------------------------|-------------------|
| ACCESSORY CARDS         | 156               |
| COMMUNICATIONS          | 156               |
| COMPUTER SYSTEMS        | 156, 157          |
| COOLING DEVICES         |                   |
| GENERAL                 | JOANNO FAST       |
| MASS STORAGE            | . Records.        |
| PERIPHERALS             | 157               |
| POWER COOLING SUPPLIES  | 158               |
| SECURITY DEVICES        |                   |
| USED EQUIPMENT          |                   |
| Evaluation Evaluation   |                   |
| SOFTWARE                | 158-164           |
| ARTIFICIAL INTELLIGENCE | 198 <sub>1</sub>  |
| BUSINESS                | 158               |
| COMMUNICATIONS          | 158               |
| DATA BASE MANAGEMENT    |                   |
| DESK TOP PUBLISHING     |                   |
| EDUCATIONAL             | HOH               |
| ENGINEERING             |                   |
| EXPERT SYSTEMS          |                   |
| FINANCIAL               | 2 Iginou          |
| GENERAL                 | Two Channe        |
| GRAPHICS                | 158               |
| LANGUAGES               | 158               |
| MULTI/USER SYSTEMS      |                   |
| NETWORKING              |                   |
| OPERATING SYSTEMS       |                   |
| PROGRAMMERS TOOLS       | 59, 160, 161      |
| PUBLIC DOMAIN           |                   |
| SCIENTIFIC              | o a. viorit. 39 M |
| SECURITY DEVICES        | 162               |
| STATISTICS              |                   |
| TERMINAL EMULATION      |                   |
| UTILITIES               |                   |
| WORD PROCESSING         |                   |

| MISCELLANEOUS            | 164-165           |
|--------------------------|-------------------|
| ACCESSORIES              |                   |
| BAR CODING               |                   |
| BUSINESS OPPORTUNITIES . |                   |
| CAREER OPPORTUNITIES     | MODELS 50, 60, 80 |
| COMPUTER INSURANCE       |                   |
| COMPUTER TRAINING        | 164               |
| DATA CONVERSION          | 164               |
| INDUSTRIAL SYSTEMS       |                   |
| PUBLICATIONS             | 165               |
| SOFTWARE DUPLICATION     |                   |
| SUPPLIES                 | 165               |

#### **ADVERTISING RATES AND INFORMATION**

PC Tech Journal Marketplace is a special economical section for product and service listings.

Listings are grouped by category and sold by column inches. Second color option available.

Standard Directory Listings are also available for a minimum of 3 issues at \$220.00 per issue (\$660 total).

For additional information call 212-503-5115.

#### **CLASSIFIED ADVERTISING STAFF**

One Park Avenue, New York, NY 10016 (212) 503-5115

Advertising Director Kathryn J. Cumberlander Sales Manager Phyllis Kenny Sr. Advertising Coordinator
Monica Dixon
Production Manager
Anne R. Brockinton
Production Coordinator
Wendy Mylett

#### **ACCOUNT MANAGERS**

Michael J. King, Account Representative (212) 503-5116

WA, HI, AZ, MT, NV, ID, ALL CA, NM, UT, CO, OR, WY, Canada

Lee Uniacke, Account Representative (212) 503-5141

AK, AL, AR, DC, DE, FC, FL, GA, IA, IL, IN, KS, KY, LA, MD, MI, MN, MO, MS, NB, NC, ND, NJ, OH, OK, PA, SC, SD, TN, TX, VA, WI, WV, CT, MA, ME, NH, NY, RI, VT, British Columbia (All Overseas Calls)

SEPTEMBER 1988

#### HARDWARE ACCESSORY CARDS

#### 72 DIGITAL I/O FOR PS/2



#### MODELS 50, 60, 80

- · Parallel Expansion
- 72 I/O Lines
- · Address Selectable

1-800-553-1170



478 E. Exchange St., Akron, OH 44304 TEL: (216) 434-3154 FAX: (216) 434-1409 TLX: 5101012726
CIRCLE 265 ON READER SERVICE CARD

IBM PS/2

PROTOTYPE BOARDS

#### COMMUNICATIONS

### NEW

- 40 MHz, 10 MIPS, Addressing 256K
- 1 Clock 16 Bit Multiply

TMS 320 C25

PC COPROCESSOR

BOARD

- · High Speed DSP, Graphics and Numerical Analysis
- External User Bus for A/D & D/A
- · Monitor Debugger & C Utilities
- Fractals, Rotations, & FFT Demos
- Source code included

\$900 board & 32K \$1100 board & 256K \$150 TMS320C25 assembler

#### SYMMETRIC RESEARCH

15 Central Way, Suite 9, Kirkland, WA 98033 206-828-6560

CIRCLE 267 ON READER SERVICE CARD

#### COMMUNICATIONS



312-359-2626

\$349 \$85 \$259 \$135

Extender Boards:

16-BIT SLOT EXTENDER BOARD - \$59.95

32-BIT SLOT EXTENDER BOARD - \$79.95

NVS CO.

Model NYS/2: \$39.95
FOR THE 165 HIS LOTS IN IBM PS/2: MODELS 55, 60, 60
FOVER 3000 1/10" PLATED HOLES WITH SOLDER PADS
FASS 16-BIT AND VIDEO BUS INTERFACE DETRISIONS
FOWER AND GROUND BUSES WITH 1/10" SPACED
HOLES APOUND EDGE OF BOTH SIDES OF BOARD
FOMES WI PLASTIC ADAPTER HOLDERS AND BRACKET

Model NVS/2-32:
• FOR THE 32-BIT SLOTS IN IBM PS/2 MODEL 80
• INTERPIN POWER AND GROUND PLANES

2124 Arbor Drive New Port Richey, FL 34655 Tel: (813) 376-8191, Telex: 4992602 IPC-INV CIRCLE 266 ON READER SERVICE CARD

#### PC TECH JOURNAL MARKETPLACE is a

special economical section for product and service listings.

Listings are grouped by category and sold by column inches.

Second color option available.

Standard Directory Listings are also available for a minimum of 3 issues at \$220 per issue (\$660 total).



Software Link Inc:
Multilink Advanced®
Lanlink ™ 5.0 starter kit
Lanlink ™ 5.0 satellite
Lanlink ™ 5X Server
Lanlink ™ 5X satellite
AT Gizmo™
PC-Emulink ™
PC-MOS™ single user
PC-MOS™ five user
PC-MOS™ 25 user

Digiboard serial boards: 4\$ 4 port 16 bit I/O \$335 8\$ 8 port 16 bit I/O \$525 44 4 port Intell I/O w/256k \$678 8I 8 port Intell I/O w/256k \$836 Call for PS-2 I/O boards

CIRCLE 268 ON READER SERVICE CARD

Companion allows you to add an extra keyboard and monitor up to 250' from your PC system unit.

Operates with Mono, CGA and EGA monitors on IBM PC/XT/AT computers and

100% compatibles.

DEALER PROGRAM AVAILABLE.

PRICES START AT \$219.00

CYBEX CORPORATION

2800 H. Bob Wallace Ave.

Huntsville, AL 35805

(205) 534-0011

CIRCLE 269 ON READER SERVICE CARD

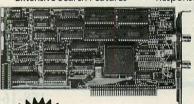
#### Turn your IBM PC into a 3270 Coax **Data Analyzer.**

#### **FEATURES:**

- Completely Passive
- Records up to 16 MB
- Function Keys, On-line Help
- Extensive Search Features
- Polls Compressed at Capture
- μ sec Accurate Time Stamps

#### **OPTIONS:**

- 3299 MPX, DFT, SNA
- Response Time Analyzer



#### CoaxScope \$2,995.00

14 Day Free Trial Evaluation

(617) 520-3800



TECHNOLOGIES 38 Pond Street, Franklin, Massachusetts 02038

CIRCLE 270 ON READER SERVICE CARD

#### **RS-422**

FOR PS/2



#### MODELS 50, 60, 80

- Two Channel
- Transfers to 256 K baud
- Address Selectable
- Interrupt Selectable

1-800-553-1170



478 E. Exchange St., Akron, OH 44304 TEL: (216) 434-3154 FAX: (216) 434-1409 TLX: 5101012726 CIRCLE 271 ON READER SERVICE CARD

#### COMPUTER SYSTEMS



THIS IS ONE OF OUR PRODUCTS ASK FOR LATEST CATALOGUE MAXTRON (818) 350-5707

1825A Durfee Ave., S. El Monte. CA 91733 CIRCLE 272 ON READER SERVICE CARD

#### FREE 6' RS232 PC CABLE!

Recieve a high quality RS232 cable for your IBM PC. There is no charge or obligation. FREE! FREE! Just send your name, company name, address, and phone number to:

- Softronics, Inc.
- 7899 Lexington Dr. Ste 210
- Colorado Springs, CO 80920 Attn: Cables
- Limit: 1 per company, while supplies last.

#### HARDWARE COMPUTER **SYSTEMS**

continues on the following page

THE COMPREHENSIVE GUIDE TO PRODUCTS AND SERVICES FOR THE MS DOS MARKET

#### **COMPUTER SYSTEMS**

#### IBM PS/2's

Up to 41% off!

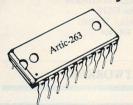
|              | Retail | Your Cost |
|--------------|--------|-----------|
| MODEL 50-386 | (New)  | \$Call    |
| MODEL 60-041 | 5,295  | 3,395     |
| MODEL 60-071 | 6,295  | 3,850     |
| MODEL 80-041 | 6,995  | 4,395     |
| MODEL 80-071 | 8,495  | 4,995     |
| MODEL 80-111 | 10,995 | 7,895     |
| MODEL 80-311 | 13,995 | 9,995     |
|              |        |           |

American Micro Computer Center 2890 Griffin Road - Suite # 4 Ft. Lauderdale, FL 33312

305)985-9406 CIRCLE 273 ON READER SERVICE CARD

#### PERIPHERALS

#### What can we say?



#### ....ANYTHING!

Phoneme Synthesizer Chip - high quality speech at low cost. Exclusively from:



(313) 588-7370 FAX: (313) 588-2650

Troy, MI 48083

CIRCLE 274 ON READER SERVICE CARD

#### Tech Marketplace...

The comprehensive guide to products and services for the MS DOS market. To place your ad Call

(212) 503-5115

#### **PERIPHERALS**

#### SPEECH PRODUCTS

For PCs and compatibles

#### SYNTHESIZER—only \$79.95

The next versatile and best sounding speech product available for under \$4000! The amazing Speech Thing provides text-to-speech as well as PCM and ADPCM speech and music reproduction. Comes with "Thing" D/A converter that attaches to the parallel printer port outside the computer-ideal for laptops. Will not interfere with normal printer operation. Also comes with audio amplifier/speaker and power adapter. Software includes two advanced text-to-speech



programs, digitized speech and music files, full screen waveform editor, sampling music keyboard, special effects mixing board, and drivers so you can add speech and sound effects to programs written in BASIC, C, PASCAL, and others. Includes 54 page manual. SPEECH THING-\$79.95

#### DIGITIZER—only \$89.95

The Voice Master PC Digitizer is a full 8-bit PCM sampler board. Fits in any available slot. Up to 15,000 samples per second. Input pre-amp has automatic gain control and 4.5 Khz low pass filter. Includes a quality headset microphone. Software included for recording and editing sound files for playback through Speech Thing. Also includes a real-time spectrum display and oscilloscope display as well as assembly language source listings for writing your own drivers. BONUS: Voice recognition program included which is callable via an interrupt vector. Demonstration program written in GWBASIC. VOICE MASTER PC DIGITIZER—\$89.95.



#### **VOICE RECOGNITION** only \$49.95

A price/performance break-through! Equal in performance to other systems costing hundreds more \$\$\$. The amazing **Voice** Master Key program adds voice recognition to just about any program or application. You can voice command up to 256 keyboard macros. Fully TSR and occupies less than 64K. Instant response



time and high recognition accuracy. Easy and fun to use—no compilers or editors required. Works with CAD, desktop publishing, word processor, spread sheet, even other TSR programs. A genuine productivity enhancer. Voice Master Key can also be called from within a program for adding voice recognition to custom applications. Voice Master Key requires the Voice Master PC Digitizer for operation. (Please note: Voice Master Key will not replace the keyboard or mouse except under certain circumstances. Not to be confused with the still unavailable "voice typewriter.") VOICE MASTER KEY-\$49.95

BONUS OFFER! Buy Voice Master Key with PC Digitizer for only \$129.95—you save \$10! BETTER BONUS OFFER! Buy all three: Speech Thing, PC Digitizer, and Voice Master Key for only \$189.95-you save \$20!

> ALL OF THESE PRODUCTS ARE OF PROFESSIONAL QUALITY. ORDER HOTLINE: (503) 342-1271 Monday-Friday, 8 AM to 6 PM Pacific Time

Add \$5 for shipping and handling on all orders. Add an additional \$3 for 2nd day delivery. All goods shipped UPS. Master Card and VISA, money order, cashiers check or personal checks accepted

Call or write for FREE product catalog.

(allow a 3 week shipping delay when paying by personal check). Foreign inquiries contact Covox for C&F price quotes. Specify computer type when ordering. 30 DAY MONEY BACK GUARANTEE IF NOT COMPLETELY SATISFIED. ONE YEAR WARRANTY ON HARDWARE.

COVOX INC.

675-D CONGER ST EUGENE, OREGON 97402 U.S.A.

TEL: 503-342-1271 FAX: 503-342-1283 CIRCLE 275 ON READER SERVICE CARD

#### **FastTRAP™**

The pointing device of the future is here!



- Two and three axis pointing capability
  High resolution trackball for X and Y axis input
  High resolution fingerwheel for Z axis input
  Use with IBM® PC's, XT's, AT's and compatibles

- Three input buttons
  Full hardware emulation of Microsoft® Mouse
  Standard RS-232 serial interface
- Includes graphics drivers and menu generator
  Easy installation
- 1 year warranty
  Made in the U.S.A.

#### ONLY \$149.00 VISA and MasterCard

LTS/C Corp. 319 South Limestone Street Lexington, Kentucky 40508 (606) 233-4156

(800) 872-7279

3-D TRACKBALL FOR IBM CIRCLE 276 ON READER SERVICE CARD

We asked our customers to tell us who had LOWER PRICES than we do.

#### They told us!

We lead the industry both in price and quality in ½" 9-track tape drive subsystems to transfer information between mainframes and PC/XT/AT, PS2

- **EBCDIC-ASCII Conversion**
- Tape backup/volume data stg. Speeds up to 7 Meg/min.
- Select & reject specific fields 800/1600/6250 BPI
- Drives from Anritsu, Cipher, Qualstar and M4 Data

Dealer & Volume Discounts



(602) 779-3341 • Telex 705609 FAX (602) 779-5998 CIRCLE 277 ON READER SERVICE CARD

#### CREATE A DISKLESS PC!

PC-ROMDRIVE allows users to create a "Diskless PC" capable of booting a ROM-resident copy of MS-DOS and/or user application programs. PC-ROMDRIVE consists of a PC-compatible ROM/ PROM expansion board and the PC-ROMDRIVE software. PC-ROMDRIVE is priced at \$195 for single units. Quantity discounts and OEM arrangements available. MC/VISA ALDIA SYSTEMS, Inc.

P.O. Box 37634 Phoenix, Az. 85069 (602) 866-1786

#### Tech Marketplace

Standard Directory Listings Available Call (212) 503-5115

THE COMPREHENSIVE GUIDE TO PRODUCTS AND SERVICES FOR THE MS DOS MARKET

#### POWER COOLING SUPPLIES

#### **TURBO-COOL 150:** Cool, Quiet Power



| MODEL       | POWER | COOLING | NOISE | PRICE |
|-------------|-------|---------|-------|-------|
| STANDARD XT | 150W  | 1.0X    | STD   | \$69  |
| STANDARD AT | 200W  | 1.0X    | STD   | \$125 |
| SQ150 PC/XT | 150W  | 1.4X    | -84%  | \$129 |
| SQ200 AT    | 200W  | 1.1X    | -69%  | \$169 |
| TC150 PC/XT | 155W  | 2.2X    | -50%  | \$149 |
| TC200 PC/XT | 200W  | 2.7X    | STD   | \$189 |
| TC250 AT    | 250W  | 1.8X    | STD+  | \$189 |

FCC; UL; 120V/240V; 4 drive plugs; heavy duty components; patented cooling system; 1 year warranty,

#### PC COOLING SYSTEMS, INC. 31510 Mountain Way, Bonsall, CA 92003 (619) 723-9513 VISA/MC/COD/PO CIRCLE 278 ON HEADEH SERVICE CARD

#### SOFTWARE

#### BUSINESS

#### **LOOKING FOR SOFTWARE?**

Can't find the right software for your needs? Look no further. We can get you anything from Educational and Business applications to advanced Programmer's Tools, all at discounted prices. Customized and standard software. No additional fees. For micros, minis and mainframes. Call for more information. Volta Info Systems 2200 North Lake Parkway, Suite 240 Tucker, GA 30084 (404) 938-9358, TELEX 446903 VOLTA USA

#### COMMUNICATIONS

#### **Bi-Directional File X-Fer**

Multi-Com telecommunications offers: \*Simultaneous Downloading/Uploading

- \*Send/Receive Messages During File X-fers
- \*100% Line Use During Multi-File Transfers
  \*Uses Full Duplex ADLC Protocol
- \*More Efficient Than Xmodern, Kermit etc. \*Saves Time and Cuts Connect Costs Information and Demo Disk . .\$5.00 + \$3s/h

Program Package 31/2 & 51/4 \$49.95 + \$4s/h Multiplex Systems P.O. Box 16174 Pittsburgh, PA 15242 (412) 276-3374 24 Hrs.

#### COMMUNICATIONS



Source and monitor modes: datascope and breakout box; ASCII and EBCDIC; trigger processing, live data display, adjustable buffer size. Custom cabling included.

800 562-8378

700 Harris Street, Suite 101 Charlottesville, Virginia 22901

CIRCLE 279 ON READER SERVICE CARD

#### "E-mail...is bargain.

Introducing SEAdog. An electronic mail system that's simple to set up. using standard phone equipment.

Faithfully send and retrieve electronic mail from one PC or from four hundred! And not just text. but

spreadsheets. programs and database files as well. Per station





System Enhancement Associates

21 New Street Wayne, New Jersey 07470 (201) 473-5153 CIRCLE 280 ON READER SERVICE CARD

#### DOS COM PORT DEVICE DRIVER

Interrupt driven device driver used for the COM ports on PC, AT & compatibles. With source code in Assembly & test program in C. Use instructions as open, close, read, write & ioctl to access your COM port data. Load driver through config.sys at boot up. \$39.95 with manual. s/h + \$5.00. CA res. add \$2.60 tax. HYTEC RESEARCH, INC. 22324 Harbor Ridge Lane, #4 Torrance, CA 90502 (213) 320-4541

To Place Your Ad Call (212) 503-5115

#### GRAPHICS



Interactive Graphics & Statistics

Create graphs the way you want them. 35 graph types can be used to create numerous renditions. Make posters and flow chartswith full screen editing of text.

- Vary character font, size,
- position, color Stack and overlay graphs
- 3-Dimensional graphs: fishnet
- Linear & Non-Linear Regression
- Stochastic Distribution
- Independence Testing
- Descriptive Statistics

Contact: Scientific Programming Enterprises, P.O. Box 669, Haslett, MI 48840 (517) 339-9859 CIRCLE 281 ON READER SERVICE CARD

#### 35mm SLIDE FROM YOUR PC

COMPUTER SLIDE EXPRESS converts graphic files produced on the IBM PC into brilliant 35mm color slides with color resolution 400% better than your monitor. Leave your printouts behind. Use high resolution color slides up to 4000 line. COMPUTER SLIDE EXPRESS \$9/slide. VISUAL HORIZONS 180 Metro Park

Rochester, NY 14623 (716) 424-5300

(301) 593-0683

#### **FORTRAN Graphics Libraries**

Now! 3 scientific graphics packages to support MS FORTRAN/Pascal, R-M or Lahey FOR-TRAN. GRAFMATIC (screen), PŁOTMATIC (HPGL, H-I plotter) & PRINTMATIC (Laser & dot-matrix printer). All fully documented. Complete graphics primitives, 2-D plots, 3-D plots and solid models. \$135 each, 2 for \$240, all 3 only \$340. Call or write for info. Microcompatibles, Inc. 301 Prelude Drive Dept. J Silver Spring, MD 20901

LANGUAGES

#### Extended Batch Language

INTEGRATE and customize your programs with EBL! Write powerful utilities, insulate your programs from novices, build custom menus automatically. Many power user features: floating point arithmetic, simulate keystrokes, if-then-else, and more. Money back guarantee. Call or write for information. \$49 + \$3 s/h.



Seaware Corp. PO Box 1656 Delray Beach, FL 33444 800/634-8188

CIRCLE 282 ON READER SERVICE CARD

#### Quick BASIC to C

BAS C translates Quick BASIC, BASICA and compiled BASIC to C automatically. Microsoft, Turbo, Lattice & Aztec C. All memory models are supported. The most beautiful, natural, structured, indented, scoped C code is generated. \$199/\$375. FREE DEMO DISK. **GOTOLESS CONVERSION** P.O. Box 835910 Richardson, TX 75083 (214) 404-1404

#### **NETWORKING**

#### KEYCARD **ELIMINATOR**

**NOVELL ADVANCED NETWARE®** V2.0a 86, 286, 286 nonded, SFT-1, SFT-2



NBS

NETWORK BUSINESS SYSTEMS

1300 Woodhollow Drive, Suite 5601 Houston, Texas 77057 713-781-9268 (Sales, Tech Support) 713-783-4457 (Administrative, Sales

CIRCLE 283 ON READER SERVICE CARD

PC TECH JOURNAL MARKETPLACE is a special economical section for product and service listings.

#### TECH MARKETPLA

THE COMPREHENSIVE GUIDE TO PRODUCTS

#### **OPERATING SYSTEMS**



#### This real time MULTITASKING KERNEL simplifies real life product development

- No royalties
- Full source code included
- C interface
- Preemptive scheduler
- Intertask messages Terminal Handler
- Dynamic memory
- **Event Manager**
- Semaphore Manager Resource Manager
- \* Buffer Manager

ly \$75 US (Shipping/handling extra)

— ask for price list. 4/50 available for 8080, Z80. AMX 68000 operates on any 68000/10/20 system

#### KADAK Products Ltd.

206 - 1847 W. Broadway Vancouver, B.C. Canada V6J 1Y5 Telex: 04-55670

Fax: (604) 734-8114
Telephone: (604) 734-2796
CIRCLE 284 ON READER SERVICE CARD

#### **PROGRAMMERS TOOLS**

#### **Eng/Sci Data Processing**

Source programs for statistics, matrix and complex number operations, curve fitting, FFT, PSD, CSD, auto/cross correlation, transfer function, noises, digital filters, and graphics. Specify QuickBASIC, BASICA, Turbo Basic, or Turbo Pascal; \$50 each. Engineering Tutorial Software 22338 Lull Street Canoga Park, CA 91304 (818) 716-0816

#### **HUMAN INTERFACE MGR FOR C**

\$18 for the HIM libraries with 110 window, menu, keyboard, and help manager functions. 220 + page reference manual. Try it. If you like it register for \$79 which buys hardbound manual, 1 year updates, support, and HIM source code. Forms manager/painter available to reqistered users. Microsoft C V5.0

. . . . Albuquerque, NM 87109 . . . . VISA . . . . . . (505) 823-9528 . . . . . . MC

#### for Version Control 1:30 PC Tech Journal says...



TLIB™ 4.0

Times are to update a 45K library on a PC/XT. PVCS and TLIB 3.0 are from Sept 87 PC Tech Journal. SRMS and TLIB 4.0 are later versions.

#### TLIB™ is FASTEST!

"TLIB is a great system" PC Tech Journal, March 88 "TLIB...has my highest recommendation." Ronny Richardson, Computer Shopper, August 87

'If you've been putting off getting a revision control system, you no longer have an excuse." The C Users Journal, February 88

A Full-Featured System for Software Professionals Branching, for parallel development. Check-in/out locking. Keywords. Wildcard and list-of-file support; creates lists by scanning source code for includes. Can merge (reconcile) multiple simultaneous changes and undo intermediate revisions. Network and IBM 3363 optical disk support.

MS-DOS 2.x & 3.x Just \$99.95 + \$5 s/h VisaMC 5 station LAN license \$299.95 + \$5 s/h call for pricing on other network sizes

**BURTON SYSTEMS SOFTWARE** PO Box 4156, Cary, NC 27519 (919) 856-0475

CIRCLE 286 ON READER SERVICE CARD

#### "Better Than Bricklin"

Use the best prototype/demo system available today. Proteus makes it easy to create modular, fully-interactive presentations. Also draw program screens, forms and charts. Menu-driven, context-sensitive help, complete documentation. 30-day guarantee. \$99. VISA/MC/COD/PO.

Helios Software P.O. Box 22869, Seattle, WA 98122 (800) 634-9986 (206) 324-7208

#### PASCAL-TO-C TRANSLATOR

Convert to UNIX and OS/2 using our 98% automatic translation tools: units, strings, denesting, all types, modules, I/O. The most complete translators for Turbo, MT+, Microsoft, UCSD, Apollo, Macintosh, others, Industrial strength licensing from \$7,500 includes technical support, source code libraries, and IBM PC/ AT executables.

(503) 745-7476 or 5880

TGL, INC.

#### **FLOATING POINT LIBRARY**

FP-51 is a set of floating point routines designed to run on the 8051 core family of microcontrollers. In source form or object.

- Efficient Prom usage
- \* IEEE subset floating point format
- \* Supports +, -, ×, %, SIN, COS, LN, EXP & SORT

Abionics, Inc.

11 Prospect Street Mt. Arlington, NJ 07856 201-770-2603

#### & MASM -DOS & OS/2

#### VersiMAKE<sup>TM</sup>

A full-featured MAKE utility that derives your system's dependencies through analysis of your C & MASM source files. No more MAKE dependency files to maintain!

VersiCREF<sup>TM</sup> A unique utility that creates a sorted Master Cross-Reference of your entire system. Handles 100+ C and MASM source files. Full X-Ref or just PUBLIC symbols.



\$125 \$75 \$150

800-334-4096 (In NJ, 609-871-0202) MC/VISA/AMEX

Free Demo Disk

#### SUMMIT INFORMATION SYSTEMS, INC.

73 East Lane, Willingboro, NJ 08046

CIRCLE 285 ON READER SERVICE CARD

#### PROGRAMMERS TOOLS

#### SCREEN MANAGER

For C, BASIC, FORTRAN, COBOL Programmers

#### The Screen Generator TM

The Screen Generator offers professional screen management for creation of Window, Help, Menu, and Data Entry Screens for over 20 compilers. You create screens using SG's Screen Painter. All screen text and field information is stored in compact screen libraries. All Screen Display and Data Entry functions are controlled from within your program. SG's function calls provide all the flexibility and speed you'll ever need for screen display and block mode or field level data entry. The Screen Generator includes: The Screen Painter/Print Utility, The Screen Manager, and 100 page User Guide.

So give us a call! You'll be up and running in no time, while our 60-day Money Back Guarantee eliminates all the risk!

#### The Screen Generator ™ — New Version

C, BASIC, ASM & Turbo Pascal **FORTRAN or COBOL** 

\$79 add \$20. VISA/MC

Demo Disk Available

#### The West Chester Group

P.O. Box 1304, West Chester, PA 19380

(215) 644-4206

CIRCLE 287 ON READER SERVICE CARD

#### OPT-TECH SORT/MERGE

The High Performance, High Quality, Sort/Merge utility. Use as a stand-alone routine or Call as a subroutine to over 30 languages. Unlimited filesize, multiple keys, record selection, and much more! MS-DOS \$149.

To Order or for more Information, Call or Write. (702) 588-3737 Opt-Tech Data Processing

P.O. Box 678/Zephyr Cove, NV 89448 CIRCLE 288 ON READER SERVICE CARD

#### ROM YOUR ".EXE

EXELOC v3.0 creates rommable files for 8088/8086 based systems from MS-DOS ".EXE" files.

Version 3.0 allows full control of segment Supports initialized data segments

Creates binary or INTEL HEX-ASCII files. Run EXELOC in batch or menu mode. EXELOC is what you need for:

CASH REGISTERS
ROBOTICS
INDUSTRIAL CONTROLLERS
BIOS DEVELOPMENT
DISKLESS WORKSTATIONS
... OR ANY FIRMWARE

Only \$59.95 U.S. plus \$3 s/h. CHK/MO. VIRTUAL SOFTWARE

150 Alton Towers Circle, Suite 605
Scarborough, Ontario, Canada
(416) 754-0711

CIRCLE 289 ON READER SERVICE CARD

#### 'C' DOCUMENTATION TOOLS

SAVE hours of debugging and documentation!

C-CALL (\$39) gives system/module level XREF or graphic-tree of all caller/called (flow) structures in a set of 'C' programs.

C-REF (\$29) gives system/module XREF of

variables/constants (incl. global vs local).
C-HDR (\$39) create/insert/update header for each module showing caller/called and local/

global/parameter identifier usage.
C-LIST (\$29) list and diagram programs, or reformats (incl. comment alignment).
SPECIAL!! All for \$89 (30-day guarantee)

SOFTWARE BLACKSMITHS INC. 6064 St Ives Way, Mississauga, ONT, Canada. L5N-4M1

(416) 858-4466

CIRCLE 290 ON READER SERVICE CARD

#### **SOFTWARE/PROGRAMMERS TOOLS**

continues on the following page

SEPTEMBER 1988 159

#### TECH MARKETPLAC

THE COMPREHENSIVE GUIDE TO PRODUCTS AND SERVICES FOR THE MS DOS MARKET

#### PROGRAMMERS TOOLS

#### **ProtoGen™**

Prototyping and Code Generation



Finally ... Software Engineering Arrives!

Introducing ProtoGen, the newest form of utility. A tool that brings you Computer-Aided Software Engineering (CASE). Its unsurpassed design features can make software development faster and easier than you ever thought possible.

Both programmers and non-programmers can build an entire userinterface without typing one line of code. Coordinate menus, windows, and context-sensitive help in a unique and intuitive environment. All the popular user-interfaces are supported so you can design, test and implement the look and feel of software applications.

ProtoGen generates Pascal or C code directly from your prototype, saving weeks, or even months of development time. Standalone prototypes are created in a few easy steps. Use the code as a starting point for construction of commercial-quality applications.

If you don't like reinventing the wheel, use ProtoGen's libraries in your applications. You get two indexed, illustrated manuals, a quickreference card, and lots of online help to get you started. And we don't restrict your creativity with licensing fees or copy protection. Advanced features like Dos commands and Outline generation let you stretch your imagination!

IBM PC, XT, AT and BIOS compatibles with 384 K, 2 drives, DOS2.1 or later.

#### **ProtoGen**

TPV1.1 for Turbo Pascal

TCV1.1 for Turbo C

MCV1.1 for Microsoft C

MacCulloch, Prymak Associates Ltd.

1411 University Ave. W.

Windsor, Ontario, Canada N8B 1B8

\$99.95 and handling

\$99.95 all prices:

\$99.95 plus shipping

1-519-256-6132

Visa/MC accepted. 291 ON READER SERVICE CARD

#### One-stop ROM Shop

When your application calls for ROM support, contact the professionals at ALDIA SYSTEMS. We've been supporting firmware developers for over two years with excellent software develop-ment tools and technical support. Don't settle for imitations, call the company who brought you PC-LOCATE, the original PC locater.

PC-LOCATE: Produce ROM-able code from your "EXE files. PC-LOCATE assigns physical addresses to the re-locatable image based on user inputs. PC-LOCATE support the entire Intel processor family including: 8086, 8088, 80186, 80188 and 80286.

PC-PROMPAK: A PROM/ROM expansion board for IBM and IBM-compatible computers. PC-PROMPAK provides up to 384Kbytes of non-volatile expansion memory and supports most 28-pin JEDEC devices including EPROMS. EEPROMS and Static RAMs.

PC-ROMDRIVE: Create a "Diskless PC" that can include MS-DOS and your application program. "Autoexec.bat" files are supported for automatic program execution.

— ALDIA SYSTEMS, Inc. —— P.O.Box 37634 Phoenix. Az. 85069 (602) 866-1786 CIRCLE 293 ON READER SERVICE CARD

#### SOURCER.

Create detailed commented source code and listings from memory, COM files or .EXE files directly suitable for assembly. Built in data analyzer and simulator resolves multiple data segments and provides detailed comments on interrupts and subfunctions, I/O ports and much more.

#### **BIOS SOURCE**

PS/2 = AT = XT = PC = Clones

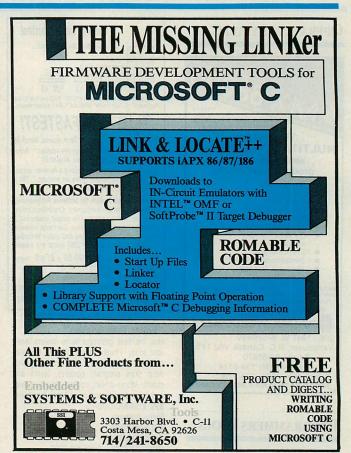
The bios pre-processor to SOURCER in proride the street means to obtain accurate legal source listings for any bios! Identifies entry points with full explanations. Provides highly descriptive data labels such as "video\_mode" and much more.

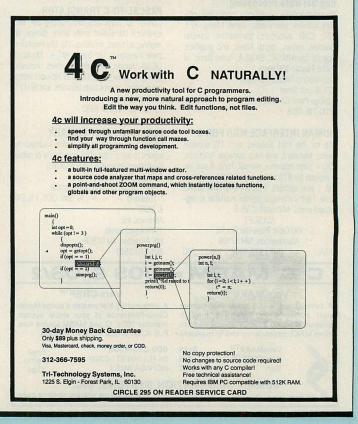
SOURCER \$ 99.95 SOURCER w/BIOS Pre-Processor \$139.95

To order or receive information just call! 800-538-8157 x 811 800-672-3470 x 811 (outside Calif.) (inside Calif.)

#### V COMMUNICATIONS 3031 Tisch Way, Suite 200, Dept. TJ San Jose, CA 95128 • (408) 296-4224

PS/2, AT, XT, PC are trademarks of IBM Corp.
CIRCLE 292 ON READER SERVICE CARD





#### PROGRAMMERS TOOLS

Attn: Systems Developers . . .

Adds exact terminal emulation

... dynamically link exact terminal emulation to your existing software. Every keystroke, every video presentation, every printer function is reproduced exactly. Written in assembler, it conserves memory and delivers unparalleled performance.

Add Terminal Emulation to:

- Communications Software
- TCP/IP & X.25 Gateways, etc.
- LAN Environments
- **INT 14 Communications Redirectors**
- **Custom Applications**

Migrate your host software to micros . . .

. without modifying keyboard and screen handling code. Application programs read the PC keyboard and write the PC screen, through Add-a-terminal®, just like the real

Over 50 Terminal Emulations to choose! Including: DEC, Data General, ADDS, Datapoint, Hazeltine, Hewlett-Packard, Honeywell, IBM, Lear-Siegler, Perkin-Elmer, Prime, Televideo, TI, Wyse, and More. Custom emulations available.

ECONOMICAL VOLUME & BUNDLING PRICING AVAILABLE! 1-800-225-8590

SUFTRONICS 719/593-9540 FAX: 719/548-1878 TELEX: 450236 CIRCLE 296 ON READER SERVICE CARD

#### **ROM DEVELOPMENT TOOLS**

Link MS-DOS and Intel object files to ROMable code. GeneLink permits independent placement of each program segment for complete flexibility in memory layout. GeneLink links directly from object files to HEX or other formats, and is five to ten times faster than other locating tools.

Genesis has been a major supplier of ROM development tools to major industrial customers like IBM and Boeing for over five years. You can count on Genesis to provide reliable, fast tools and excellent support.



Genesis Microsystems Corporation 196 Castro St., Mountain View, CA 94041

Call: (415) 964-9001: TX: 4998093 GENMS III CIRCLE 297 ON READER SERVICE CARD

#### TECH MARKETPLACE . . .

Standard directory listings available. To place your ad:

(212) 503-5115

#### ATTENTION DEVELOPERS

Now you can reduce your development time and improve the quality of your applications with JAM. Create and link together screens, pop-up windows, and menus-all without code. Features include: context-sensitive help, shifting and scrolling fields, extensive data validations, testing, plus much more.

#### **Key Benefits:**

- Extremely portable
- Available for most computers, operating systems and languages
- ► Unmatched power and flexibility
- Permits access to a variety of database products
- ► Toll-free technical support hot-line

Call today for more information and price quotes.

1 (800) 458-3313

In NY State. (212) 267-7722 Fax No. (212) 608-6753

Excellence in Systems & Application Design CIRCLE 298 ON READER SERVICE CARD

#### ACCESS

- Screen Design
- Remote Support
- Interrupt Driven Async
- Application Security Interfaces to C, Basic, Pascal, Assembler, Cobol. Condensed screens. No Royalties.

Guaranteed satisfaction. \$245. VISA/MC/COD Trilobyte Software Systems 295 Los Angeles Blvd. San Anselmo, CA 94960 (415) 457-3431

CIRCLE 299 ON READER SERVICE CARD

#### **MS-DOS for VAX**

- DEVELOP PC applications
- DEBUG PC code
- RUN as if on a PC
- All as a VMS process

M software inc 708 W. Huron Ann Arbor, MI 48103

313/761-5800 CIRCLE 300 ON READER SERVICE CARD

#### **Quick Basic Phone Tools**

Develop your own voice and Touch Tone' processing applications using the Watson ™ telephone interface board and Quick Basic 4.0. Record and playback speech files/Program control with Touch Tones™/Telephone control Demonstration programs are provided

- Demonstration Provided Health State 

  Record and playback 

  Record and playback 

  Voice Messaging 

  Voic Our Phone Tools are \$150.00 (Includes 1 runtime license from National Micro Systems Inc.) Var boards are available for \$199.00 Not copy protected.

Chelsea Software
P.O. Box 2664, Tulsa, OK 74101
(918) 789-3185

Watson's is a registered trademark of Natural Micro-Systems, Inc. Touch Tone's is a registered trademark of AT&T, Inc. CIRCLE 375 ON READER SERVICE CARD

#### TOOLS FOR MS WINDOWS & PRESENTATION MANAGER

For accounting or other networked multifile applications. Speed development! Save months! Four modules: graphical file maintenance, start up (password etc.), help and report. Must have SDK. Source available. No royalties. MW Tools \$995, PM Tools \$1495. The Software Factory

Gainsville, FL 904-376-8370

#### MULTI-TASKING TOOLKIT

Write your "C" programs with cooperating, concurrent tasks using INTERWORK useful for real-time applications and com-

- puter simulation. Features:
   more than 100 tasks

 inter-task communication facilities
 DOS interrupt handling
PC-DOS version \$129, Henry \$159, Unix \$249; source code \$995. Shipping included; 2 day air add \$5. For more information, contact:



13563 NW Cornell Road, Suite 230 Portland, Oregon 97229 (503)241-8971 CIRCLE 395 ON READER SERVICE CARD

Tech Marketplace . . . the comprehensive guide to products and

services for the MS DOS market.

THE COMPREHENSIVE GUIDE TO PRODUCTS AND SERVICES FOR THE MS DOS MARKET

#### PUBLIC DOMAIN

#### Public Domain Software in C

Over 150 volumes of public domain software for MSDOS, UNIX AND CP/M.

- small expert systems and graphics
- editors, compilers, text formatters
- · many UNIX-like tools & misc. utilities Write or call for more details. Send \$10 for comprehensive directory.



The C Users' Group PO Box 97 McPherson, KS 67640 (316) 241-1065



- Embed a secure serial number string
- Track unauthorized copies back to their source.
   EVERTRAK is totally invisible to your end user and uses latest encryption technology. EVERTRAK supports IBM & Compatibles using DOS 2.0 of later, sells for \$295.00 and has a 30 day money back guarantee.



Az-Tech Software, Inc. 305 East Franklin Richmond, MO 64085

(800) 227-0644 (816) 776-2700 CIRCLE 379 ON READER SERVICE CARD

he world's leading software manufacturers depend on Softguard copy protection systems. Your FREE DISKETTE introduces you to SuperLock™ - invisible copy protection for IBM-PC (and compatibles) and Macintosh.

- Hard disk support
- No source code changes
- Customized versions
- LAN support
- New upgrades available

(408) 773-9680

#### SOFTGUARD SYSTEMS INC.

710 Lakeway, Suite 200 Sunnyvale, California 94086 FAX (408) 773-1405

CIRCLE 377 ON READER SERVICE CARD



#### TERMINAL EMULATION **BARR High-Performance RJE Workstations**

BARR/SNA RJE and BARR/ HASP are communications hardware/software packages for the IBM PC and PS/2 series of computers.

#### Full featured:

- · multiple printers,
- · unattended operation,
- print speed beyond 6,000 lpm,
- · special forms,
- · line speed to 56,000 bps,
- · dial-up or dedicated lines, and
- serve as a LAN gateway.

BARR/SNA RJE emulates IBM 3777-3 in an SNA environment. BARR/HASP emulates IBM 3777-2 and HASP on the 360/20. BARR communications software is also available with PC-SYNC internal modems: 208AB, 201C, 9600.



Barr Systems, Inc. 2830 NW 41 St. Bldg M Gainesville, FL 32606 800-BARRSYS or 904-371-3050

CIRCLE 380 ON READER SERVICE CARD

#### SECURITY DEVICES

# COPY PROTECTION

Designed for user-transparency, clone compatibility & strength. It features:

- complainting a strength. It reactives, no need for damaged media or 1.0 plugs supports all Hard & Floppy disk formats file-server networks supported variable number of instalts (0-99) create demos with remote unlock option allows protected upgrades by modern/BBS limit program use by date or count \$195 Starter Kit or \$495 with NO meter counts. Free info & demo disk available



Az-Tech Software, Inc. 305 East Franklin Richmond, MO 64085

(816) 776-2700 (800) 227-0644 CIRCLE 376 ON READER SERVICE CARD

#### **DataCr**

From the Creators of PROTEXT

DataCrypt - 1) A unique and unbreakable software encryption system designed to provide BUSINESSES, GOVERN-MENT AGENCIES and INDIVIDUALS with TOP LEVEL SECURITY while retaining, receiving and transmitting classified information.

-Coded data is unbreakable (exceeds Data Encryption Standard)

- No "back door." Cannot be reverse engineered or "jammed"
   Menu driven and user friendly with on-line tutorial
- -Encodes all types of files at speeds up to 100K cpm -Every system produces unique codes based on unique keys
- -Full control over encryption keys provides endless security

-Authentication, audit trail, verification, scanners and more DataCrypt, the ultimate security system, can be obtained for \$249 -or- inquire about a site license.

For TOP LEVEL security call PC IDEAL today at 1-800-634-5641 -or- send check/money order to:

PC IDEAL, Inc. Executive Suites

650 Sentry Park, Suite #1, Blue Bell, PA 19422

"Finally, an IDEAL data security solution, DataCrypt." CIRCLE 378 ON READER SERVICE CARD

#### LITILITIES

#### TECH MARKETPLACE...

Standard directory listings available. To place your ad

Call (212) 503-5115

#### **BIT-LOCK® SECURITY**

Piracy SURVIVAL 5 YEARS proves effectiveness of powerful multilayered security. Rapid decryption algorithms. Reliable/small port transparent security device. PARALLEL or SERIAL port. Countdown and timeout options also available. KEY-LOCK™ security at about ½ BIT-LOCK cost. MICROCOMPUTER APPLICATIONS 7805 S. Windermere Circle Littleton, CO 80120 (303) 922-6410 or 798-7683

#### Tech Marketplace,

the home of the power buyer.

#### **Compress Your Data 10X FASTER!!**

- PKARC & PKXARC can significantly INCREASE DISK STORAGE CAPACITY and reduce file transfer times!
- PKARC & PKXARC can compress your files even smaller and up to TEN TIMES FASTER than the other ARChive program.
- Data encryption capability too! Not copy protected.
- "PKARC/PKXARC is the system to use." -Dr. Dobbs Journal of Software Tools
- "Lightning-fast", INFOWORLD

Only \$45 + 3.50 s/h. WI res. add 5% sales tax. 7032 N. Ardara Ave., Glendale, WI 53209 (414) 352-3670 PHware Inc.

CIRCLE 381 ON READER SERVICE CARD

#### CH MARKETPLA

#### UTILITIES

#### AT's DON'T NEED 360KB DRIVES

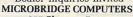
The 1.2MB drive has long been known to **READ** but **NOT** reliably **WRITE** on 360KB floppies. With "**CPYAT2PC**" 1.2MB drives **CAN** reliably WRITE 360KB floppies saving a slot for a second hard disk or backup tape. "CPYAT2PC" (Not Copy Protected) offers the preferable SOFTWARE SOLUTION.

- NO software or hardware modification
- A 360K drive is NOT required
  "CPYAT2PC" program MAY reside on hard disk
  Runs on IBM PC/AT and COMPATIBLES
- i.e. Compaq Deskpro 286/386, AT&T 6300 +, HP Vectra, Sperry PC/IT, Tandy 3000

Only \$79.00 + \$4.00 S/H VISA, MC, COD, UPS-B/R ORDER TOLL FREE 1-800-523-8777



TELEX EZLINK 62873089 Dealer Inquiries Invited



655 Skyway #125 San Carlos, CA 94070 CA 415-593-8777 NY 212-334-1858 CIRCLE 382 ON READER SERVICE CARD

#### Fix common problems fast!

You don't need to be an expert to diagnose and correct problems in volving PC setup. All you need is HELPME™ software! More than 300 tests. Quick identification of system configuration and compatibility. \$99 + S/H. MC/VISA. California Software Products, Inc., 525 N. Cabrillo Park Drive, Santa Ana, CA 92701, (714) 973-0440. CIRCLE 383 ON READER SERVICE CARD

#### THE SPINDRIFT LIBRARY

At last!! Now there's a way for the FORTRAN programmer to do the things they have always wanted to do: Execute other programs via CALL EXEC; diet control of the cursor with edit keys; WINDOWS on the screen for POP UP HELPs; (\*) and (?) wildcard file searches; save/restore screen images; COLOR screens

These are just a few of the features of the SPIN-DRIFT Library. Over 150 subroutines and functions in all, the SPINDRIFT Library includes DOS Interface (COPY, ERASE, MKDIR, FINDFILE, SYSTEM, etc), Variable Length Strings, Security Routines, Date/Time Routines, 10 SORT Routines, and much more!

Price: \$149 plus shipping/handling to ra DEMO DISK: \$5.00 credited toward purch Specify your FORTRAN Compiler

Spindrift Laboratories, Ltd. Arlington Heights, Illinois 60005 (312) 255-6909

CIRCLE 384 ON READER SERVICE CARD

#### YOUR DOS DREAMS COME TRUE

STILL RIVER SHELL, NEW VER 2.44. Faster more powerful version of this popular DOS shell. Find copy, move, delete files in a few keytrokes. \*Tagging \*Find on name and text \*Full Tree \*User defined commands and more. \$39 complete with 160pp, manual, Unitd, site lic. \$390. MC/VISA. 90-Day No-Risk Guarantee. **Rill White** 

P.O. Box 57 Still River, MA 01467 (617) 456-3699



ARC is considered the industry standard archive utility. It's the file storage method used by PCTECHline. And PC WEEK called it "A sophisticated

and eminently useful product."

ARC automatically compresses stored data so it takes up less space. And less modem transfer time From 20% to 90% less, depending of All program sources are included and it's not copy



CIRCLE 385 ON READER SERVICE CARD

#### SERIAL I/O DRIVER

COM1-COM8 DOS device driver for PS/2 Models 50, 60, and 80. Interrupt driven, buffered I/O. Loaded via CONFIG.SYS. Extended BIOS for buffer control and monitor. All serial lines accessible via high level languages or BIOS calls. \$129.00 + \$3.00 S/H. Diamond Control Systems, Inc. 400 W. Bethany Drive, Suite 140 Allen, TX 75002 (214) 727-8511

Tech Marketplace Home of the Power Buyer

#### d28c 0419 >move dx,ss Quaid Analyzer cc8b 041b move cx, sp fa 041d Instruction Display cli c88c 041e move ax,cs d08e 0420 move ss, ax 0000 0000 0d60bc 0422 move sp,0d60 dx ax ds:si bx 86c4:003e 085d 0200c481 0425 add sp,0200 es:di cx 86c4:0000 0a9a fb 0429 sti ss:sp bp 86c4:0946 00a2 52 042a push dx 51 042b data 09c2:0008 push cx 09c2:0419 53 042c push bx code 51 042d 09c2:0419 push cx cs: ip ...oditsz.a.p.c 30b4 042e move ah, 30 0000001001000110 21cd 0430 int DOScall flags

#### Part of a Quaid Analyzer display

Quaid Analyzer is a powerful diagnostic tool that shows what is going on inside your computer. The > at the top is the cursor. You can move it with the arrow keys. When you move the cursor off the screen, the instructions scroll like text in an editor. You can move the cursor into a register and change its value, or see the instructions or data it points to. Of course, you can scroll through the data display as well, and type new values into memory. With Quaid Analyzer you never have to type a command.

This example shows the first instructions executed when VDISK.SYS installs itself. You can see that it changes stack pointers, then gets the DOS version number. We got to this point by loading Quaid Analyzer before DOS, then watching the DOS call and disk interrupts until the driver was loaded, then putting a breakpoint on its first instruction. Drivers are installed before DOS gives you the first prompt. What other software tool can show you a device driver install?

Quaid Analyzer comes with a manual, and software on a 3 inch and a 5 inch diskette. If you are not satisfied with Quaid Analyzer, you can return it within 30 days for a refund. Quaid Analyzer is not sold by dealers in the United States or Canada. It is not copy-protected.

To order Quaid Analyzer, call us with your credit card, or send us a check for \$200 US funds. We ship within a day at our expense.



Quaid Software Limited Third Floor Dept T633 45 Charles Street East Toronto Ontario Canada M4Y 1S2

(416) 961-8243

Warning!

For advanced programmers only.

CIRCLE 386 ON READER SERVICE CARD

#### SOFTWARE/UTILITIES

continues on the following page

SEPTEMBER 1988 163

THE COMPREHENSIVE GUIDE FOR THE MS DOS MARKET

LITILITIES

#### If you can find better sort/merge software.

Sortex:<sup>®</sup> A flexible, general purpose sort/merge facility which provides you with the ultimate in performance and reliability



- Runs from the DOS prompt, batch file, or applications written in Assembler, BASIC, COBOL, FORTRAN, Pascal, or C.
- Accepts your requirements through the full screen menu/panel facility, control file, or command line.
- Processes most of the commonly used file and data types.
- Produces output files with key, address, index, tag, or full records.
- Imposes no practical limitations. Files with four billion characters, records & fields with thirty two thousand characters each, and unlimited number of keys can be handled by Sortex.
- Allows records to be chosen selectively for processing.
- Sorts your records in ascending/descending order on any number of keys.
- Merges your sorted record sequences into one sequence on any number of keys.
- Preserves the input order of records on the output file if all their keys are identical.
- Allows keys to overlap, or be contained within other keys. They need not be
- Processes files that contain both standard and nonstandard delimiters.

30-Day Money-Back Guarantee Only \$149.95 \$49.95



CORPORATION

1915 W. Orangewood Avenue Orange, California 92668 Tel.: 714 978 0480

CIRCLE 387 ON READER SERVICE CARD

#### SEE CURRENT FILE ACTIVITY

WATCH-I-O. Pop-up utility that displays files open, DS:DX of open and last read/write, R/W counts, last exec, last open, last file-not-found. User can select hot-key, pop-up for file opens, pop-up for file-not-found, track file opens on printer. Only \$49.95 w/anti-virus option \$69.95. MC/VISA.

Quantum Publishing 23860 Miles Road Cleveland, OH 44128 1-800-342-6237

#### **DISK ACCELERATOR V2.0**

DiskCache speeds up your hard disk access. Disk caching and ram disk in one package. Ram disk shares cache space. Transparent, flexible, configurable, no h/w changes. RAM, EMS, and AT extended memory versions incl. Not copy protected. VISA, MC, volume discounts. No PO's w/o prior approval. \$49.00 DATAMORPHICS LTD. P.O. Box 820 Stittsville, Ontario, Canada KOA 3G0

#### MISCELLANEOUS

#### **BAR CODING**

Or call (6.13) 831-0409



#### BAR CODING

#### **BAR CODE &** MAGNETIC STRIPE READERS for the IBM PC & PS/2 Simple & quick installation

No additional software or port Metal wand & case Also available:

Bar code printing software Magnetic stripe encoders Units for other computers & terminals GSA pricing available

TPS ELECTRONICS 4047 Transport Street Palo Alto, CA 94303

Telephone: 415-856-6833 Telex: (Graphnet) 371-9097 TPS PLA FAX: 415-856-3843 CIRCLE 388 ON READER SERVICE CARD

#### PC-WAND

#### BARCODE BARGAINS

NEW - WANDERWAND BARCODE READER

Think of everything you would ever want in a barcode reader and you'll find it in the new ITS 5308 system! Programmable • Handheid, lightweight • Simple connection with standard RS 232 plug • Holds up to 48,122 characters • Discriminates between label codes, time stamp labels • Calculates and dumps scans • Wand included.

ITS 5306 - PC Wand Barcode Reader. Emulates keyboard • Reads codes UPC, Codabar, 3 of 9, 2 of 5 interleaved • Works with IBM PC's and clones • Lowest cost · versatile, high quality!

PCDOS-MSDOS Printing Software. Generate your own labels on your existing Matrix printer • Call for details.

nternational Technologies & Systems Corp. 1950 White Star Dr., Diamonal Bar, CA 91765 PHONE:1-(714)861-7977 • TELEX 6502824734 MCI

GUARANTEED LOWEST PRICES TO S

CIRCLE 389 ON READER SERVICE CARD

#### **Bar Code Headquarters**

Bar Code Readers for PC, XT, AT, PS/2, Kimtron, Wyse, Link or any RS-232 terminal. Attaches as 2nd keyboard and inputs data as though keyed. With rugged stainless steel wand— \$399 complete. Also Laser Readers. Badge Readers, MagStripe Readers, and Portable Readers.

Print Bar Codes on all popular dot matrix printers and HP compatible laser printers. Menu driven or "user callable." All popular bar codes plus several sizes of big text up to 1" tall, readable at 50 feet. Fast, Easy, Well Documented. Several programs from \$49 to \$279.

Choose from the industry's largest selection of PC related hardware and software-direct from the manufacturer/developer. Same day ship. 1 year warranty. 30 day money back guarantee.

#### JORTHINGTON

DATA SOLUTIONS (800) 345-4220 CA (408) 458-9938 417-A Ingalls St. Santa Cruz, CA 95060

#### COMPUTER INSURANCE

#### SAFEWARE

Safeware Insures your computer. provides full replacement of hardware, media, and purchased software. As little as \$39 a year provides comprehensive coverage. With our blanket coverage, no lists of equipment are needed. One phone call does it all! Call 8am - 10pm ET Monday thru Friday. (Sat. 9 - 5) SAFEWARE, The Insurance Agency Inc. 2929 N. High Street, P.O. Box 02211 Columbus, Ohio 43202

800-848-3469 National

614-262-0559 Ohio CIRCLE 391 ON READER SERVICE CARD

#### COMPUTER TRAINING

#### C Language Training

\*Introduction to C (3 days).

\*Techniques of C (2 days).

\*Training on your site + expenses.

Public classes. 5 days @ \$895/student. Classes given monthly in Collingswood, NJ. Call for info. Handouts, Code Examples & Textbook included.

Computer Language Arts, Inc. 704 Haddon Ave. Collingswood, NJ 08108 (609) 858-2552

#### DATA CONVERSION

#### **Optical Scanning**

Text, graphics, program lists, manuals, etc. converted to micro-computer format. Fast turnaround time. Surprisingly low prices.

Call us at: 1-800-426-3776

TROPUS, Inc. 1303 Clear Springs Trace Louisville, KY 40223 **CIRCLE 392 ON READER SERVICE CARD** 

#### TAPE/DISK CONVERSIONS

Conversion services to or from over 1000 comnuter-systems:

- Magtapes
- Micro Computers
- Mini Computers
- Word Processors
- Typesetters

Our conversion capabilities surpass most in the PIVAR COMPUTING SERVICES, INC.

165 Arlington Hgts. Rd. #T Buffalo Grove, IL 60089 (312) 459-6010

#### TECH MARKETPLACE.

Second Color Option Available

THE COMPREHENSIVE GUIDE TO PRODUCTS AND SERVICES

#### **PRODUCT CATEGORIES**

#### **HARDWARE**

ACCESSORY CARDS

MASS STORAGE

**COOLING DEVICES** 

PERIPHERALS

COMMUNICATIONS

SECURITY DEVICES

COMPATIBLES

**USED EQUIPMENT** 

**GENERAL** 

#### **SOFTWARE**

ARTIFICIAL **INTELLIGENCE**  MULTI/USER SYSTEMS

BUSINESS

**NETWORKING** 

**OPERATING SYSTEMS** 

COMMUNICATIONS

PROGRAMMERS TOOLS.

DATA BASE

**PUBLIC DOMAIN** 

**MANAGEMENT** 

**EDUCATIONAL** 

SCIENTIFIC

**ENGINEERING** 

SECURITY DEVICES

**EXPERT SYSTEMS** 

STATISTICS

**FINANCIAL** 

TERMINAL EMULATION

GENERAL

UTILITIES

GRAPHICS

WORD PROCESSING

LANGUAGES

#### **MISCELLANEOUS**

**ACCESSORIES** 

DATA CONVERSION

**BAR CODING** 

**PUBLICATIONS** 

BUSINESS

**OPPORTUNITIES** 

SOFTWARE **DUPLICATION** 

COMPUTER

**INSURANCE** 

#### SUPPLIES

#### **PUBLICATIONS**



- Stepping & Servo Motor Controls Ruggedized PC's Rack Mtg. 80286 & 80386
- Laboratory Automation 1 MHZ A/D
- Digital Scopes to 200 MHZ
- High Speed Bus Adapters
- Mayeform Synthesizers
  Data Loggers
  PC Bus Expansion Chassis
  And Much More

203-786-5151號

Cylenescarding P.O.Box 9565, New Haven, CT 06536 Fax: 203-786-5023 Telex: 9102501037

enables you to configure the BEST products from the world's leading PC hardware and

software vendors into risk free

turn-key system solutions that meet your needs.

Toll Free Hotline for application assistance and convenient one stop shopping at competitive prices. 100% Satisfaction Guaranteed.

CIRCLE 393 ON READER SERVICE CARD

#### Tech Marketplace...

Second Color Option Available

Call (212) 503-5115 For More Information

#### SUPPLIES

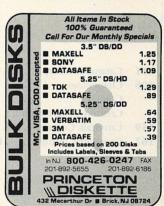
FIND THE WIDEST RANGE OF DP WORKSTATIONS.

ACCESSORIES & SUPPLIES IN THIS FREE GLOBAL GUIDE DIAL





45 South Service Road, Plainview, NY 11803 CIRCLE 394 ON READER SERVICE CARD



CIRCLE 396 ON READER SERVICE CARD



clients and distributors. Ziff-Davis reprints are custom-designed and will make your product's review an attractive marketing lure.

If you're looking to land the big one this summer, contact Jennifer Locke—Reprints Manager, Ziff-Davis Publishing Co., One Park Ave., NY, NY 10016, (212) ZD 503-5447, or on MCI Mail. (Min. order 500 reprints.)

0

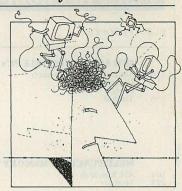
| INDEX TO ADVERT   | ISERS   | PC TECH JOURNAL SEPTEMBER 1988  |
|---|---|---|
| READER<br>SERVICE NUMBER ADVERTISER   | PAGE READER ADVERTISER PAGE   | READER SERVICE NUMBER ADVERTISER PAGE   |
| 116       Adv. Log. Res.       Back G         253       AI Architects       *         *       Aker Corp.       *         109       Apollo Computer, Inc.       *         164       AST Research, Inc.       *         171       ATI Technology, Inc.       *         203       Atron       *         165       Attachmate Corp.       * | Cover 115 26 20 & 21 1  | 175       Programmer's Connection.       19         173       Programmer's Paradise.       153         162       Programmer's Shop.       144         151       Programmer's Shop.       126         161       Progress.       33 |
| 102 Blaise Computing, Inc   |   | * SAS Institute   |
| 110       Digiboard.         121       Digi Data         221       Digital Research   | 146<br>140  | 166       Solution Systems       149         130       Solution Systems       14         177       Stargate Tech       151         152       Symmetry Group       25  |
| <b>127</b> Everex   | 224       Nantucket Corp.       10         191       Norcom       3         201       Novell Devel. Div.       5         Nu-Mega Technologies       2 | 156 Tandon 124 & 125<br>225 Tecmar 136<br>153 Telebyte 34<br>138 This is How 28<br>158 Thomas Conrad 78   |
| 119 FairCom   | * Oracle Corporation  | * Vermont Creative Software 17 204 Video 7  |
| <ul><li>140 Idea Associates</li></ul>   | 27 193 Plottworks, Inc 109  |   |

| IN                                   | INDEX TO PRODUCTS PC TECH JOURNAL SEPTEMBER 1  |   |                           |  |   | I JOURNAL SEPTEMBER 1988  |
|--------------------------------------|--|---|---------------------------|--|---|---|
| RS#                                  | PRODUCT  | ADVERTISER  | PAGE                      | RS#  | PRODUCT   | ADVERTISER PAGE   |
| 1116<br>* 127<br>156                 | IBM AND COMPATIBLE PO<br>Advanced Logic Research<br>Compag<br>Everex<br>Tandon  MULTIFUNCTION/MEMOR<br>AST Research<br>Tecmar                    | COMPATIBLE Back Gatefol<br>Compaq Computers .<br>Step 386/20                              | 41<br>84 & 85<br>24 & 125 | 203<br>102<br>206<br>*<br>119<br>113<br>123<br>259<br>106<br>191<br>201<br>155<br>233<br>214<br>215<br>193 | PROGRAMMER'S TOOLS Atron Blaise Computing Inc. Chancelogic Inc. Creative Programming Faircom Haventree Software Matrix MetaWare Inc. Multi Systems Development Norcom Novell Development Division Nu-Mega Technologies PC Express Peacock Systems, Inc. Periscope Company Plotworks, Inc. | PC Probe  |
| 140<br>112                           | ACCELERATOR BOARDS IDEA Associates Micronics   | PS2 Boards  | 52 & 53<br>106            | 144<br>166<br>130<br>152   | Polytron Corporation<br>Solution Systems<br>Solution Systems<br>Symmetry Group<br>Vermont Creative  | PVCS 50 C-Worthy 149 Brief 14 Slate 25 Windows for Data 17  |
|                                      |  |   | onemie)<br>Desear         | 132<br>133   | Knowledge Ware<br>Meta Software   | CASE 93<br>Design/2.0 102   |
| 171<br>204                           | GRAPHICS SYSTEMS/CARI<br>ATI Technologies<br>Video Seven   | EGA WonderFast Write VGA  | 35                        | 194<br>138   | SOFTWARE UTILITIES Pocket Soft, Inc. This Is How  | RTLinc. 99 KnowHow 28   |
| 111<br>121<br>108<br>185<br>34       | MASS STORAGE HARDWAR<br>Catamount Corporation<br>Digi Data<br>Innovative Data Tech.<br>Overland Data<br>Telebyte                                 | 9 Track Tape System 9 Track Tape 9 Track Tape FAME 9 Track Hardware Telebyte Tape Drives. | 107                       | * 141 224 * 151 161 176  | DATA MANAGEMENT SOFT<br>Aker Corporation<br>Micro Data Base Systems<br>Nantucket Corporation<br>Oracle Corp.<br>Programmers Shop<br>Progress<br>Raima Corporation   | Magic PC         26           MDBS III         135           CLIPPER         109           Oracle DBMS         11           CLEAR         126           PROGRESS         33 |
| 165                                  | MICRO-MAIN FRAME/MINI<br>Attachmate Corporation  | COMMUNICATIONS EXTRA  | 117                       | 253<br>174<br>137  | OPERATING SYSTEMS AI Architects Mortice Kern Systems, Inc. Quarterdeck Office System  | OS/286 and OS/386   |
| 101<br>196<br>158<br>*<br>120<br>115 | LOCAL AREA NETWORKS LAN Systems, Inc. Software Link Inc. Thomas Conrad Corp. TOPS, A Sun Microsystems Co. Virtual Machine Technology WordPerfect | LAN Spool<br>LANLink.<br>ARCNET Products<br>TOPS.<br>Arc Net<br>LAN                       | 147                       | 103<br>221   | MULTI-USER SYSTEMS Bristol Information Systems Digital Research   | Music/386   |
|                                      |  |   | blem r                    | 187  | Scott Foreman & Co.   | Publications  |
|                                      | OTHER COMMUNICATION  |   | CAJ III                   |  | actual confinity)   |   |
| 110                                  | Digiboard, Inc.<br>Stargate Technologies   | Open Ender Board  |                           | 109<br>*<br>107  | OTHER SERVICES Apollo Computer, Inc. Microsoft Corporation SAS Institute Inc. Scientific Endeavors Corp.  | Series 3000 & Series 3500       20 & 21         Microsoft University       . 150         The SAS System       . 74 & 75         VTEK 4.2       . 108                        |
| 159<br>167<br>170<br>230             | COMMUNICATION SOFTWA<br>Crosstalk Communications<br>Crosstalk Communications<br>Innovative Technology Inc.<br>Meridian Technology                | Remote II   | ack Cvr.<br>148           | 146<br>175<br>173<br>162   | MAIL ORDER Microway Programmer's Connection Programmer's Paradise Programmer's Shop   | Mail Order       154         Mail Order       19         Mail Order       153         Mail Order       144  |
| 263<br>*<br>145                      | LANGUAGES  Mansfield Software Microsoft Corporation Microsoft Press  | Personal Rexx<br>LANGUAGE—MASM<br>Quick Basic Prog. Toolbox                               | Cvr. 2                    | 157<br>189   | SECURITY DEVICES Rainbow Technologies, Inc. Software Security   | Software Sentinel 80<br>The Block 31  |

SEPTEMBER 1988

## PROFESSIONAL VIEWPOINT

Public enemies number one and two to LANs are bad managers and vendors who are not supportive after the sale.



According to an informal survey of *PC Tech Journal* readers, the biggest problems facing local area networks (LANs) are disinterested upper-level management and inferior vendor support. Respondents say that these culprits can sever the LAN ties that many organizations heavily depend on to integrate users, computers, and information systems.

Slow performance, high memory consumption, and difficulties mixing equipment also are high on the list of problems. Lack of reliability and problems with installation, maintenance, security, backup, and cabling, receive dishonorable mentions.

Gloria Sharrar, lead programmer/ analyst, Sovran Financial Corporation, Richmond, Virginia, summarizes the management issue: "LANs require extensive administration to set up users and printers and to keep everybody operating at an optimal level at all times. Sad to say, most departments won't train or hire someone who is technically proficient enough to maximize the benefits of a LAN."

Trying to get vendor support is a nightmare for many LAN managers. "When something doesn't work, the LAN hardware people point at the LAN software people, and the LAN software people point at the computer hardware people, who point at the computer software people, who point right back to the LAN hardware people," explains Michael Ser, software specialist, Ital-Cable USA, New York, New York.

The technical issue of memory hoarding eventually may be alleviated as OS/2 gains acceptance; for now, however, it is a major problem for DOS-based systems. "Network device drivers take at least 70KB from the system, leaving too little memory to run common applications. A major improvement would be to make the device drivers into terminate-and-stayresident programs (TSRs), which could

be [unloaded] without rebooting the system," recommends Joel Leavitt, systems manager, Gould Electronics, North Andover, Massachusetts.

Of LAN *non*performance, Todd Fritsche, manager of research and development, Foodcom Inc., Malvern, Pennsylvania, says, "We have five programmers with 80286-based machines (10 MHz) connected to a dedicated server via 10-Mb/s Ethernet coaxial cable. The server runs NetWare 286, has a 19-millisecond disk, and 2MB of memory. We have spent hours finetuning the system and still drag it to its knees during heavy development. It is a shame to have an expensive system support only five users!"

Connecting different LANs, software, hardware, and operating systems is no easy matter, either. As new operating systems, bus architectures, and incompatible programs proliferate, this situation is likely to worsen.

Matt Sonnentag, software and hardware consultant, Lockheed Space Operations Company, Kennedy Space Center, Florida, says that his problems include "too many different kinds of LANs with too many different architec-

tures, operating systems, and so on; getting AT clones to work with a LAN; [lack of] software support and compatibility; and LAN-to-LAN and LAN-to-wide-area-network (WAN) connectivity."

Maintenance and troubleshooting system crashes are problems for many respondents, including Dan Meyer, information systems coordinator, Vanalco, Vancouver, Washington: "When [the LAN] goes down, it can take quite some time to find the cause due to the number of segments and terminals. Our cable is spread out among six buildings and more than 200 acres."

#### **EASING TROUBLE SPOTS**

To smooth out the rough spots in LAN operation, managers can take some cues from the many shared problems reported. Educating upper-level management should be an ongoing priority.

Memory shortage problems can be addressed to a limited extent using expanded memory or special software drivers, such as 386-to-the-Max from Qualitas Inc. (see Product Watch, Steven Armbrust, December 1987, page 197). With network and applications software continuing to use more memory, solutions such as OS/2, UNIX, and 386 DOS-control programs—all exploiting the greater addressing capabilities of 286 and 386 processors—deserve serious consideration.

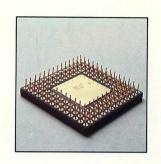
Because network performance often depends more on the sophistication of applications software than actual performance of the LAN, the future availability of true data-server software (such as SQL database servers) may speed many operations.

LAN vendors also can take heed from these findings. Respondents believe that good customer support is essential for LANs, not a mere luxury as it may be with simpler computer systems. Enhancing customer support for LANs can go a long way toward gaining a marketing edge.

168 PC TECH JOURNAL

MIXING

EQUIPMENT



Being the first to use the 80386 chip, we established one fact.



## "...you don't have to be based in Texas to build the world's fastest PCs."

1988

Welcome to California, the zero wait state.

In July of '86 Advanced Logic Research was the world's first manufacturer to release an 80386 based PC, adding to a long list of California firsts.

Today at ALR, we manufacture the world's fastest PCs. Industry peers have recognized the FlexCache 386

series as the ultimate tool for the most demanding business applications in network, multi-user and CAD/CAM environments.

NOVELL

"The ALR FlexCache 20386 will make a name for itself as a heavy-duty file server. ...the FlexCache is destined for success."



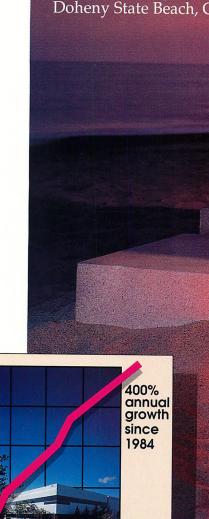
excerpts from Editors Choice MAGAZINE June 28, 1988

The ALR FlexCache 20386 Model 150 achieved a rating of 19.7 in Byte Lab. "Tops in price and performance'

Byte June, 1988

" The performance they achieve sets a new standard for PCs."

Resource June, 1988



"ALR has come out of nowhere over the last two years to earn a spot in the sun among important PC-compatible makers." - Jim Seymour January 12, 1988

" Well, for once the answer isn't to run right out and get your hands on a Compag Deskpro 386/20.™ Rather, it's to get your hands on an ALR FlexCache 20386."

> First Looks March 15, 1988



" ... the FlexCache 20386 yields the highest number of MIPS (million instructions per second) per dollar."



#### Redefining PC Speed

Although we can't go any further west, ALR is claiming new frontiers in PC performance and processing speeds. Now, fast is even faster. The ALR FlexCache 25386 breaks every current speed record. Our proprietary 64Kbyte Extended Emulation 82385 ™is the key to 25386 Cache speed.

|  | ALR<br>FlexCache   | Compaq<br>Deskpro  | IBM PS/2<br>70 386          | ALR<br>FlexCache   | IBM PS/2<br>70 386                               |
|--|--|--|-----------------------------|--|--|
| Models   | 20386-150  | 386/20-130   | 8570-121                    | 25386-150  | 8570-A21   |
| Microprocessor                                   | 80386<br>20MHz<br>32KB,<br>82385<br>Memory<br>Cache (35ns) | 80386<br>20Mhz<br>32KB,<br>82385<br>Memory<br>Cache (35ns) | 80386<br>20MHz<br>0-2 wait- | 80386<br>25MHz<br>64KB<br>Extended<br>Emulation<br>82385<br>Memory<br>Cache (25ns) | 80386<br>25MHz<br>64KB<br>Memory<br>Cache (30ns) |
| Bench Mark<br>Data Base Power Meter<br>Ver. 1.2  | 4.71 Mips  | 4.59 Mips  | 3.53 Mips                   | 6.09 Mips  | 5.74 Mips  |
| Optional Math<br>CoProcessor                     | 80387 20MHz  | 80387 20MHz  | 80387 20MHz                 | 80387 25MHz  | 80387 25MHz                                      |
| Memory (RAM)                                     | 2MB (80ns)   | 1MB (100ns)  | 2MB (85ns)                  | 2MB (60ns)   | 2MB (80ns)                                       |
| Storage<br>1.2MB, 5 1/4" FD<br>1.44MB, 3 1/2" FD | 1<br>Optional (\$225.00)                                   | 1<br>Optional (\$245.00)                                   | Not Available               | 1<br>Optional (\$225.00)   | Not Available                                    |
| Fixed Disk sta. Opt. Internal Full               | 150MB (18ms)   | 130MB (18ms)   | 120MB (23ms)                | 150MB (18ms)   | 120MB (23ms)                                     |
| Height Fixed Disk                                | 150MB or 300MB   | No Support   | No Support                  | 150MB or 300MB   | No Support                                       |
| Video  | Optional<br>16 bit VGA<br>(\$399.00)                       | Optional<br>16 bit VGA<br>(\$695.00)                       | VGA                         | 16 bit VGA   | VGA  |
| Price  |  |  |                             | \$9499.00  | \$11,295.00                                      |

Prices and configurations as of June 1988 and subject to change.

Now that things are get'n kind'a slow in Texas...

...go West young man. Call ALR for the world's fastest PCs, under the California Sun.

1-800-444-4ALR



Advanced Logic Research, Inc.

9401 Jeronimo, Irvine, CA 92718 Phone: 714-581-6770 FAX: 714-581-9240

Telex: 510-601-4525

Answer back Advanced Logic



PC performance is redefined.

